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PROCEEDINGS

OF THE

ROYAL SOCIETY OF MEDICINE

EDITED BY
SIR JOHN Y. W. MACALISTER

UNDER THE DIRECTION OF
THE EDITORIAL COMMITTEE

VOLUME THE FOURTEENTH

SESSION 1920-21

PART III

SECTIONS:—
OBSTETRICS AND GYNÆCOLOGY ODONTOLOGY OPHTHALMOLOGY
OTOLOGY PATHOLOGY PSYCHIATRY SURGERY
THERAPEUTICS AND PHARMACOLOGY
TROPICAL DISEASES AND PARASITOLOGY UROLOGY WAR

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SECTION OF OBSTETRICS & GYNÆCOLOGY

LONDON
LONGMANS, GREEN & CO., PATERNOSTER ROW
1921

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Section of Obstetrics and Gynæcology.

President—Mr. J. D. MALCOLM, F.R.C.S.Ed.

Conjoint Meeting of the Section with the North of England and Midland Obstetrical and Gynæcological Societies, held May 6, 1920.

MORNING SESSION.

The PRESIDENT.

IN the name of the Section of Obstetrics and Gynæcology I have very great pleasure in welcoming the members of the North of England Obstetrical and Gynæcological Society and of the Midland Obstetrical and Gynæcological Society to this conjoint meeting. I invite Dr. J. E. Gemmell, vice-president of the North of England Society, to take the chair.

DISCUSSION ON THE TREATMENT OF ANTE-PARTUM HÆMORRHAGE.

Professor HASTINGS TWEEDY.

IT is an error to consider all ante-partum hæmorrhages other than those arising from placenta prævia as accidental, yet this is a mistake commonly made by nurses and students. Of still greater importance is it to determine the amount of loss which brings the condition within the category of accidental hæmorrhage. The standard at present varies in the compilation of different statistics and comparison of results is rendered difficult.

In the Rotunda Hospital the term is now not used unless the bleeding is sufficient to necessitate the presence of an assistant master, who has to make a diagnosis and is responsible for the woman's delivery. He is not summoned unless his presence is required in the interest of the patient, and many insignificant bleedings escape being recorded. Thus the fact is explained that during my entire mastership I reported but forty-nine cases of accidental and forty-five of unavoidable hæmorrhage in 13,924 deliveries, and in the extern maternity forty-seven in 15,543 deliveries.

On the other hand, Sir William Smyly, in his first hospital report, adopting a different standard, records forty-four cases in 3,600 deliveries. Most of them, he writes, were of little consequence. Similarly St. Mary's Hospital, Manchester, encountered 105 cases of accidental hæmorrhage in the two years 1913-14, eighty-three of which recovered under the measures applicable for the condition in its less severe form —viz., rupture of membranes, &c. Seven died in spite of this treatment and fifteen were dealt with by more radical procedures. From these figures I infer that there were certainly twenty-two serious hæmorrhages, but the remainder could probably be classed, with Sir William Smyly's cases, as " of little consequence."

Amongst my forty-nine patients, twenty-two were in serious danger and were treated by the vaginal plug. I lost two of my hospital patients, and in the extern maternity seven, a not surprising difference when it is remembered that greater difficulties are encountered in district work and the smaller experience of those in charge of the extern maternity. The plug was employed in five of the extern maternity deaths. My two deaths probably arose from intraperitoneal hæmorrhage, for in one it is remarked that not more than a pint and a half of blood poured into the uterus, whilst in the other the notes say that the patient's condition improved whilst the plug was in. Labour started and the delivery was natural in three hours. She died after completion of the third stage.

In 1915 I returned to the Rotunda, and, in conjunction with Sir William Smyly and Dr. Purefoy, carried on the work of the Institution for three years We encountered twenty-three cases of accidental hæmorrhage. We were then in possession of the knowledge that accidental hæmorrhage might arise as the result of pregnancy toxæmias, and this knowledge made us decide to perform Cæsarean section when the double complication was encountered in a severe form. We carried out the procedure three times and with success. Intra-abdominal blood was observed in all three operations, and in one the ovarian artery beneath the Fallopian tube was bleeding. Of the remaining twenty-one, eight were plugged. No deaths occurred from loss of blood. One woman died from sepsis ten days after delivery. Thus my hospital experience comprises seventy-two cases in over 18,000 deliveries, with two deaths. Thirty were plugged. Smyly, working in the same Institution, had five deaths in 3,600 patients treated before his adoption of the plug.

These figures are convincing in their significance, and can only be explained on the assumption that the plug exercises a definite and pronounced influence in arresting hæmorrhage. It does so by impeding the circulation in the uterine vessels. Various other explanations have been given of the plug's action, and many of these by their ineptitude have greatly prejudiced the method. Many suppose that a back pressure on the blood-vessels is caused by the outpoured blood above the plug. This explanation is quite inadequate and justifies Berkeley and Bonney in writing that "on first consideration the logic of plugging the vagina to arrest bleeding that is going on some distance above it, may not appear obvious, yet its efficacy in cases with free external hæmorrhage is proven." These writers satisfy themselves that the efficacy of the plug depends on its increasing the power of the uterus to contract. When dealing with concealed accidental hæmorrhage, however, with the accompanying uterine inertia, they are driven to express a doubt whether the plug can have any directly useful effect. They say "it is easy to apply" and that it has this great advantage, that it avoids rapid emptying of the uterus, a proceeding which always impresses severe shock on these patients. "We think there can be no doubt that in some of these cases the bleeding has stopped by the time the practitioner comes on the scene, and that plugging the vagina has the great advantage of compelling him to pursue a course of masterly inactivity."

A plug applied in the method recommended by these writers will not compress the vessels, for they apply it with the aid of a speculum and a forceps and use for this purpose rolls of cotton, each tied round with a string to facilitate removal. I feel sure it would not be possible to place in position one dozen such rolls as are portrayed in their illustration, and those adopting any similar technique must meet with disappointment.

I have quoted from the work of the above authors, not because they are singular in their views, but for the reason of their great eminence. They undoubtedly voice the popular opinion—i.e., that it is useless to attempt the compression of blood-vessels by a vaginal plug.

On the other hand, I maintain that compression is accomplished with the plug which I apply, and have demonstrated this truth during the performance of several Cæsarean sections. These have afforded my assistants an opportunity of directly observing stoppage of pulsation in the uterine artery whilst pressure is made from below on a lateral fornix.

To plug efficiently the left hand should be passed into the vagina with the palmar surface directed towards the hollow of the sacrum, while the tips of the fingers lie behind the cervix. Small pieces of cotton wool, squeezed out of lysol solution, and each the size of the thumb knuckle, are then taken and inserted by means of the right hand round the cervix. The fingers of the left hand are kept busy squeezing the pellets into a compact mass and forcing the spaces between them to permit the insertion of still another plug. This process is continued in a systematic manner from above downwards till the vulva is reached and the vagina can hold no more. A T-bandage is applied to keep the plug in position, and an abdominal binder is fastened tightly from above downwards to press the side walls of the uterus against the vaginal dam, and thus completes the operation. A plug so applied will cause immediate cessation of hæmorrhage, and, when it is removed after the lapse of hours, so much blood only will be found as can be accounted for by the flow which took place during the operation.

The vaginal plug is not easy to apply, nor is its application harmless. Sometimes, in spite of our best efforts, we cannot at the first attempt insert sufficient material to stop the bleeding. In such cases the plug must be removed entirely and reinserted. On the second attempt the procedure will be found to have become much more easy on account of the dilatation of the vagina. Pain, distress and some shock always follow from its application, and superficial tearing of the mucous membrane of the vagina is almost certain to occur, whilst the possibility of rupture of the uterus is not to be discounted.

It is clear that the words "vaginal plug" mean in Dublin something different from that which they mean elsewhere, and critics must take this into consideration.

To what extent intraperitonal hæmorrhage can be controlled by a vaginal plug is still a matter of doubt. In the vicinity of the internal os, control is complete. On the other hand, it would utterly fail to stop a leakage from the ovarian artery. The latter supplies a relatively small amount of blood to the placenta, chiefly flowing to its upper portion where detachment is rare. When the main supply is cut off the loss of blood pressure promotes coagulation in the sinus.

Hysterectomy has no place in the treatment of accidental hæmorrhage, and finally it may be stated that rupture of the membrane does not contra-indicate the vaginal plug.

Dr. J. E. Gemmell (Chairman).

We have listened with great interest to Dr. Hastings Tweedy's paper on the treatment of ante-partum hæmorrhage, and the description of what has been known to us as the "Dublin method" of treatment by vaginal packing, and are impressed by his confidence and the success which has attended this method in his hands.

In considering ante-partum hæmorrhage, we must first define the class of cases to which we refer, for we meet a very large number in maternity hospital practice in which there is hæmorrhage in the later months of pregnancy, and which have very properly been sent in "because there is some bleeding," but which are never serious, and for which rest in bed, under observation, is the only treatment required to bring them to a satisfactory conclusion as normal labour, with very little loss of blood.

It is however with the more serious cases in which there is retro-placental and retro-membranous hæmatoma that we wish to deal, and in which the most important factor is inertia of the uterus. The basis of treatment should be founded upon the surgical axiom "put your finger upon the bleeding spot," which in these cases is unfortunately of practical impossibility, as a *direct* method, but which can in some measure be obtained by *indirect* means. The vaginal pack and abdominal binder are thus employed and, used on one occasion only, I found it eminently successful. Few practitioners, however, although so frequently attempting to pack the vagina before sending the patient into hospital, are able to carry out this method properly. We are familiar with the so-called packing, which in reality is but the placing of a vaginal tampon, which has not and cannot have any effective pressure upon vessels.

I have always advocated the expectant treatment, especially in the hands of the young practitioner and the midwife, and except for the most extreme cases of retro-placental hæmorrhage, have seen most satisfactory results. Morphia brings rest to the patient and uterus, resulting in an improvement in muscular tone as a result of the recuperation of the uterus during the rest obtained, and a thrombosis of the superficial vessels. Hurried delivery, or accouchement forcé, are most dangerous, and if the degree of hæmorrhage indicates rapid delivery, then the method ought to be that of Cæsarean section without hysterectomy. Placenta prævia is more amenable to direct pressure. In multiparæ I would advise version and the half-breech as being the more practicable method for the general practitioner, whose handling of the De Ribes' bag, through a want of familiarity with vaginal operations may render its use a dangerous method. In primiparæ, with a closed cervix and increasing hæmorrhage, in the hands of those familiar with the technique of abdominal surgery, I would unhesitatingly advocate Cæsarean section.

Dr. W. FLETCHER SHAW (Manchester).

I am sure we have all listened with great pleasure to Dr. Hastings Tweedy's paper, and we must congratulate him on the excellent results he has had in accidental hæmorrhage. I am glad he has called attention to the loose way these cases are diagnosed. All maternity hospitals, St. Mary's, Manchester, as much as any of them, publish large figures of accidental hæmorrhage each year. If a patient is admitted for ante-partum hæmorrhage and no placenta is felt she is classified as accidental hæmorrhage, but I am sure many of these cases are in reality cases of marginal placenta prævia, in which the placenta is implanted so high that it is not felt on examination.

I have used the Dublin method of tightly packing the vagina in several cases of accidental hæmorrhage with good results, but no better than the method we usually employ at St. Mary's of rupture of the membranes, a tight abdominal binder and administration of ergot or pituitrin.

We must remember that a maternity hospital in a large centre has two functions to perform, and while the treatment of patients is of the first importance, the method adopted and taught to students must be the one which they can most easily carry out in after practice, when they will be responsible for similar cases. The great objection to the method of packing the vagina in cases of accidental hæmorrhage is the risk of sepsis. The most alarming symptom which confronts the practitioner in charge of a case is hæmorrhage; it is so obvious that unless it is controlled, the patient will die, and it appears equally obvious that the hæmorrhage can be controlled, so naturally the practitioner confronted suddenly with this condition adopts the method which has been taught as infallible, whether the necessary materials are to hand or not. Those of us who have had experience in a maternity hospital which receives large numbers of patients sent in by outside practitioners must have seen many cases packed in an appalling manner.

Many such cases are sent into St. Mary's packed with strips of the bed sheets, after a cursory dip in an antiseptic solution, and I have seen one case packed with a dishcloth. A patient with hæmorrhage has a much lowered resistance, so it is no wonder that many of these cases develop puerperal sepsis. It is little satisfaction to the patient to have her death certificate filled in as puerperal sepsis instead of accidental hæmorrhage. Accidental hæmorrhage is a rare condition, and we cannot expect a busy practitioner constantly to carry sterilized material for vaginal packing on the off-chance of encountering one, so I never teach packing for any obstetrical complication, and prefer in the case of accidental hæmorrhage to teach rupture of the membranes, a tight binder and ergot or pituitrin. This method is equally efficacious, and not open to the same risk of sepsis.

The great majority of cases of accidental hæmorrhage are only slight ones, but there are a few rare cases, in which no treatment short of abdominal section will control the hæmorrhage. In October, 1916, I read the notes of six such cases before this Section which I had operated upon in the previous two years, and in the same period Dr. Clifford had five cases: in all of these cases there were extensive hæmatomata in one or both broad ligaments, and in three free blood in the peritoneal cavity. These cases are rare, and since that date no similar case has occurred at St. Mary's Hospital.

Dr. Hastings Tweedy has confined his paper to accidental hæmorrhage, but I should like to say a few words on the treatment of placenta prævia. Many of these cases are slight, and provided they are in hospital or the doctor remains with the patient so as to be prepared to act if sudden severe hæmorrhage occurs, they are better left alone. If the hæmorrhage is severe the classical treatment of version is an almost sure way of controlling the hæmorrhage. In a few cases Cæsarean section is the best treatment, and I have now performed this operation on six patients with the cervix only slightly dilated, with severe hæmorrhage and with a living child.

Dr. Herbert Williamson.

The Maternity Ward of St. Bartholomew's Hospital was opened for the reception of patients on February 4, 1911. Between that date and the day on which I gave up charge of the ward in July, 1919, 2,600 patients were admitted. Of these patients ninety-eight, or 3·76 per cent. of the total admissions, suffered from ante-partum hæmorrhage.

These figures are of no value in estimating the frequency of ante-partum hæmorrhage because many of the patients were admitted on account of this symptom, and had the bleeding not taken place would have been delivered in their own homes. All the patients were under the charge of myself and my colleague, Mr. Barris; the majority were seen before delivery by one of us, and we were responsible for the treatment adopted in all the cases.

On dividing the cases into two groups according as hæmorrhage occurred from the detachment of a normally, or an abnormally, situated placenta, I find that of the ninety-eight, fifty were cases of accidental hæmorrhage and forty-eight of placenta prævia. Considering first the accidental hæmorrhages I find: nine cases of concealed hæmorrhage; twenty-four cases of external hæmorrhage; seventeen cases of the combined variety. Of the mothers, forty-seven recovered and three died; of the children, twenty-seven were born alive and twenty-three were born dead. The mortality-rate was therefore: maternal, 6 per cent., fœtal, 46 per cent.

Of the unavoidable hæmorrhages: twelve were cases of central placenta prævia, twenty-seven were cases of lateral placenta prævia, and nine were cases of marginal placenta prævia. Of the mothers, forty-five recovered and three died; of the children, sixteen were born alive and thirty-two were stillborn. The mortality rate was therefore: maternal, 6·25 per cent.; fœtal, 66·6 per cent.

The complications of pregnancy and the puerperium were as follows:

Albuminuria.—Accidental hæmorrhage, seventeen cases = 34 per cent.; placenta prævia, three cases = 6·25 per cent.

Post-partum Hæmorrhage.—Accidental hæmorrhage, twelve cases = 24 per cent: placenta prævia, five cases = 10·4 per cent.

Local Infection manifested in the Puerperium.—Accidental hæmorrhage, six cases = 12 per cent.; placenta prævia, twelve cases = 25 per cent.

There were no cases of general infection.

The treatment adopted was as follows :—

(1) *Rest in bed, Injections of Morphia, &c., but no Local Interference,* thirty-seven cases : Accidental hæmorrhage, twenty-nine cases = 58 per cent. ; placenta prævia, eight cases = 16·6 per cent. In the ninety-eight cases, therefore, thirty-seven cases, or 37·7 per cent. were delivered without interference. It must be remembered that these patients were treated under exceptionally favourable conditions—skilled assistance, a trained anæsthetist and an operating theatre were immediately available if any emergency arose. In these circumstances we were justified in a policy of non-interference until the loss was really profuse, and this policy we adopted.

(2) *The above Treatment together with Rupture of the Membranes.*—Eight cases : Accidental hæmorrhage, three cases ; placenta prævia, five cases.

(3) *Bi-polar Version and bringing down a Leg.*—Eleven cases : Accidental hæmorrhage, two cases ; placenta prævia, nine cases.

(4) *Manual Dilatation of Cervix and Forceps Delivery.*—Accidental hæmorrhage, three cases.

(5) *Champetier de Ribes' Bag.*—Placenta prævia, eighteen cases.

(6) *Cæsarean Section.*—Three cases : Accidental hæmorrhage, two cases ; placenta prævia, one case.

(7) *Plugging the Vagina and Application of an Abdominal Binder.*—Eighteen cases : Accidental hæmorrhage, eleven cases ; placenta prævia, seven cases.

I will consider the cases treated by plugging in further detail. My attention was first called to the method by Colclough's paper in the *Journal of Obstetrics and Gynæcology ;* when I read it I realized that, if reliable, this method would be the safest to teach students who were to become general practitioners and who might at any time be called upon to treat these cases in the patient's own home. I determined, therefore, to try it in a series of cases. The cases selected were those in which uterine contractions were not present and the cervix was not sufficiently dilated for bi-polar version or the introduction of de Ribes' bag. The plugging in each case was performed under an anæsthetic, and narrow strips of gauze were used instead of the pledgets advised by Dr. Hastings Tweedy. I will classify the results into four groups.

Group I : Bleeding arrested, Labour Pains excited, and no further treatment required.—Eight cases = 44·4 per cent. : Placenta prævia, three cases ; external accidental hæmorrhage, two cases ; concealed accidental hæmorrhage, one case ; mixed accidental hæmorrhage, two cases.

Group II: Bleeding arrested, but no Labour Pains excited.—Three cases 16·6 per cent.: Placenta prævia, one case; external accidental hæmorrhage, one case; mixed accidental hæmorrhage, one case.

Group III: Bleeding arrested for a time, but recurred after an interval of not less than three hours.—Three cases - 16·6 per cent.: Placenta prævia, two cases; external accidental hæmorrhage, one case.

Group IV: Hæmorrhage not arrested and treatment abandoned in favour of other methods.—Four cases 22·2 per cent.: Placenta prævia, two cases; concealed accidental hæmorrhage, one case; mixed accidental hæmorrhage, one case.

In 61 per cent. of the cases therefore the bleeding was arrested; in 39 per cent. it was not arrested permanently, although temporarily arrested in 16·6 per cent.

Amongst these eighteen cases there were two deaths, 11·1 per cent. Both patients were desperately ill before the plug was applied. The first was a toxæmia case, the urine was loaded with albumin, the uterus was hard, globular and distended. The patient died whilst preparations for Cæsarean section were being made and post-mortem a quantity of fluid blood and clot was found in the abdominal cavity. In the second, attempts had been made to apply forceps through an undilated cervix in a case of central placenta prævia. When admitted, the patient was bleeding profusely from the lacerations which had resulted. The cervix was less than half dilated and uterine pains were present. I, therefore, plugged to arrest the bleeding from the cervix. The bleeding was arrested until the cervix was fully dilated. I then performed craniotomy and delivered. There was severe post-partum hæmorrhage and the patient died two hours after delivery. I do not believe we could have saved the lives of either of these women had we adopted any other line of treatment, for both were desperately ill when first seen.

Of the children, thirteen were stillborn, four were born alive and in one case the patient died undelivered. In five cases there was post-partum hæmorrhage. In three cases evidence of local infection was manifested during the puerperium.

My experience has convinced me that plugging the vagina is a valuable method of treatment in ante-partum hæmorrhage, and that by its application the bleeding can be arrested in many cases. It is by no means infallible and those who employ it will meet with some disappointments; but it is less risky than any method of rapid dilatation of the cervix. I now teach that, excluding cases of concealed hæmorrhage of the toxæmic variety (which in my opinion should be treated by

Cæsarean section), where uterine contractions are not present and there is no dilatation of the cervix, if simple measures have failed to arrest the bleeding, plugging should be employed. Where the cervix is sufficiently dilated to admit two fingers it is better, either to practise bipolar version or to introduce Champetier de Ribes' bag.

I cannot accept Dr. Hastings Tweedy's explanation of the action of the plug for two reasons. First, because I believe it is impossible to occlude the uterine artery merely by pressure applied from below or to produce any kink sharp enough to stop the flow of blood. When an artery is compressed it must be compressed against something hard. Secondly, even if the uterine arteries were compressed, this would not stop the bleeding because of the very free anastomosis between the uterine and ovarian arteries. It is quite unjustifiable to say that the upper part of the uterus is supplied by the ovarian and the lower part by the uterine arteries; each part of the uterus is fed by both arteries. Nor is Dr. Tweedy correct when he says that comparatively little blood is brought to the gravid uterus by the ovarian arteries. I believe the action of the plug is by stimulating muscular contraction.

There is one other point to which I should like to call attention—namely, the importance of blood transfusion in severe ante- and post-partum hæmorrhage—and I suggest that those working in hospital maternity departments should be tested with regard to the agglutinating reactions of their blood to determine their suitability as donors in cases of emergency.

Mr. W. Blair Bell.

With regard to accidental hæmorrhage, I have been much interested to hear from Dr. Tweedy, for the first time from his own lips, the method he practises in packing the vagina. I can imagine none more efficient. Nevertheless, he has failed to convince me that he completely compresses the uterine artery. It is against all physical ideas that one should be able to obliterate a movable tube by pressure on one side. Nor can I believe that the uterine artery is compressed at the side of the uterus. This does not appear to me to be possible anatomically. I do, however, believe that the fundus of the uterus may be compressed between the binder and the packing in the vagina; indeed, we have long taught students to compress the uterus between a fist in the vagina and a hand above in cases of post-partum hæmorrhage. I have no doubt that hæmorrhage may be controlled by the Dublin method, but I do not think that accidental hæmorrhage, as such, is likely to be adequately treated in all cases, for, as others have said, this is a difficult procedure for ordinary practitioners to attempt. I quite agree with the statement that a majority of cases are of very little importance, and that serious cases of accidental hæmorrhage are very rare; but when they are serious they are very serious. It is, therefore, most important that the practitioner should have a ready and easy treatment in his hands.

I am much surprised that no one has mentioned the use of infundibulin in these cases. I believe that rupture of the membranes and the administration of infundibulin is the best treatment for the practitioner to employ. There are cases, of course, in which surgical intervention may be required.

With regard to the treatment of placenta prævia I hold strong views. I am certain that the proper treatment in a large majority of cases is Cæsarean section. I do not say in all cases, of course, for some cases of marginal placenta prævia are delivered almost normally and without danger; but most of the cases should be subjected to Cæsarean section, for the cervix is usually undilated, or only slightly opened. Any other method of treatment leads to the sacrifice of about 70 per cent. of the children, and is by no means free from maternal mortality. I am, indeed, convinced that Cæsarean section affords no more danger to the mother than version and delivery of the child *per vias naturales*. Those who still hold to version as the treatment of election must, therefore, justify their indifference to the fate of the child.

Dr. Herbert R. Spencer.

I think Dr. Hastings Tweedy has done good service in giving us the benefit of his large experience in the treatment of accidental hæmorrhage. Not the least valuable of his remarks is the calling attention to the fact that cases of "accidental hæmorrhage" of slight degree are very common, are of no serious consequence, and need no special treatment. This conclusion will be arrived at by every obstetrician who while young enough and energetic enough has the opportunity of attending a large out-door maternity. At the age of 27 I was in that position and in six years personally attended over 100 cases of ante-partum hæmorrhage. I cannot help feeling that it is want of sufficiently extensive practical experience that leads to too frequent resort to operative measures in these cases. I should like to call attention to the Report[1] on 254 cases of accidental hæmorrhage at the New York Lying-in Hospital which showed that of 103 cases delivered spontaneously—after rupture of the membranes (sixty-eight cases), cervico-vaginal plugging with gauze (twenty-seven cases), or dilating bag (eight cases)—only three died; while of eighty-one treated by version or extraction, ten died; of twenty-nine delivered by forceps three died; of five delivered by vaginal section one died; and of seven delivered by abdominal Cæsarean section none died.

I agree with Dr. Hastings Tweedy in deprecating hysterectomy. Some of the rare severe concealed cases require the conservative Cæsarean section: I have performed the operation twice and the cases did well.

With regard to plugging the vagina my practice has been not to employ this method, which if improperly carried out is dangerous. I do not think, however, we can fail to admit that as carried out by Dr. Tweedy it is an effective and fairly safe method, and as it avoids the dangerous operative methods it is undoubtedly of value.

With regard to Cæsarean section in cases of placenta prævia, there are cases in which it is indicated; but in my experience they are rare. I can recall two fatal cases out of a very large number attended in which it would have been better to deliver the mother by its means. The child will often succumb in cases of placenta prævia even when delivered alive, owing to its prematurity After version followed by natural delivery the mother can subsequently have children, usually without danger, which is not the case after Cæsarean section.

Dr. FOTHERGILL.

I regard packing in ante-partum hæmorrhage as an obsolescent form of treatment, unnecessary in hospital and pernicious in private on account of the painful regularity with which it is followed by septic infection. No one who has seen what I have seen in the slums and hospitals of Manchester would take the responsibility of advising students to use this method. Even more grave is the onus taken by those who, as I am informed, teach midwives to pack the vagina. The Central Midwives Board when asked for a ruling on this point of conduct, stated that

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[1] J. A. Harrar, *Bull. Lying-in Hosp. of the City of New York*, 1917, p. 151.

"the teaching is in the hands of the examiners;" but, later, instructed the examiners to accept the teaching of recognized authorities. Now there are plenty of recognized authorities on academic obstetrics; but there is only one on the behaviour of midwives, and that is the Central Midwives Board. As it refuses to pronounce on the subject, an expression of the feeling of this meeting as to whether midwives should or should not plug the vagina would be of great interest. What skilled and experienced men do in hospital and teach to their students of medicine must be left to themselves to decide; but what midwives are allowed to do is another matter altogether, and one on which unformity should be secured. It is a point of conduct, not of therapeutics.

DR. GORDON FITZ-GERALD.

The treatment of the two outstanding ante-partum hæmorrhages has for many years been the field of contention between obstetric schools. The two conditions, accidental hæmorrhage and unavoidable hæmorrhage need to be discussed separately.

(1) *Accidental Hæmorrhage:* (*a*) *External.*—There is a marked tendency to stamp this or that school as the champion of this or that line of treatment of this condition without any reference to what the behaviour of the uterus may be when the hæmorrhage occurs. If the uterus is contracting—e.g., the woman is having labour pains, when the hæmorrhage occurs, there is no need to do anything, the uterus will by its own action control the hæmorrhage. It is the treatment of those cases in which there are no labour pains when the hæmorrhage is going on that divides the schools. Personally my primary experience was gained in the Dublin school, where as is well known plugging of the vagina has so long been advocated. To this line of treatment I still rigidly adhere. The criticism that plugging of the vagina tends to convert an external into an internal or concealed hæmorrhage is, I am thoroughly convinced, entirely devoid of any but theoretical support. Every case of external accidental hæmorrhage in which there was no uterine action taking place that I have treated has been treated by plugging, and I am yet to see one in which the plugging has produced a concealed hæmorrhage. The treatment does not make the saving of the child a certainty, nor does any other older recommended method. For this reason the advisability or otherwise of doing Cæsarean section in these cases must come up for consideration. I have not yet done

Cæsarean section for this complication of pregnancy, but I appreciate the possibility of its usefulness in this respect.

(*b*) *Concealed.*—I was recently told by a newly qualified member of our profession that Dr. X in the course of his lectures had informed his class that there was only one method of treating concealed accidental hæmorrhage and that was by extirpation of the uterus. Well, we all admit that a teacher to be convincing must be emphatic. When, however, this subject is brought under the limelight of discussion we must admit that there are very few, if any, who have seen a sufficient number of cases of this condition to be as emphatic as the gentleman in question.

Extirpation of the uterus may be necessary and justifiable. From the time I started to study medicine I have only seen four cases of true concealed accidental hæmorrhage. Two I saw with another consultant and two in my own practice. The two that were not my cases were both moribund and died before anything could be done. In one of mine I removed the uterus and the woman died. In the other I did Cæsarean section and the woman recovered.

That plugging, if correct for external hæmorrhage, is also suitable for concealed hæmorrhage is incorrect. In the case of external hæmorrhage the fact that the hæmorrhage appears externally is an indication that the uterus is capable of resisting distension and forces the blood to escape externally, while in the concealed form this resisting power has been lost and distension goes on to almost any extent. It is on this that the treatment by plugging almost entirely relies for its support. I do not involve obliteration of the uterine arteries in my support of plugging. This same lack of vitality on the part of the uterus appeals to me as being a contra-indication to the adoption of measures of the nature of *accouchement forcé*.

In all cases of concealed accidental hæmorrhage I would do Cæsarean section, and if the retraction of the uterus was not satisfactory I would go on to extirpation of the uterus. The extreme rarity of the condition renders one's remarks distinctly theoretical.

(2) *Unavoidable Hæmorrhage.*—From my advocacy of plugging for external accidental hæmorrhage where there is no uterine action it may be gathered that I give support to turning and bringing down a leg in vertex presentations or pulling down a leg in podalic presentations for the treatment of this condition. Apart from Cæsarean section, however, it must be admitted that any treatment which has been advocated has for its primary object the saving of the mother's life. The child has but little chance. The more or less recent support given to Cæsarean

section has, however, in its favour the fact that both mother and child are given a decent chance. I have not done many Cæsarean sections for this condition, but I have been impressed with the fact that the loss of blood from which the woman has suffered had no relation to her chances of recovery. We see the same thing exemplified in cases of rupture of extra-uterine pregnancies in which the loss has been very great. I am sure we have all been impressed by the extraordinarily good results which we get in extra-uterine pregnancy cases, even in those cases in which the patient is almost moribund at the time of our undertaking the operation. The last case in which I operated for placenta prævia—last week—was one in which the patient had lost a very great deal of blood before she was sent into hospital. During her preparation for the operation she had another severe hæmorrhage which flooded her as high up as her waist, and which led to her being almost pulseless at the wrist, when placed on the operation table. She was blanched and suffering severely from air hunger. The anæsthetic given was chloroform and oxygen—mainly oxygen. Her recovery has, I am glad to say, been uninterrupted, and the child, though only an eight months' one, is doing extremely well.

Whether we should discard the older methods of treatment of these hæmorrhages and adopt altogether Cæsarean section as our line of treatment, will almost if not entirely depend on whether we can by a comparison of results arrive at the stage of being able to place entire reliance on the uterine scar which is left after our operation.

Dr. T. W. Eden.

I agree generally with the position taken up by Dr. Fletcher Shaw. It is important that students should be taught methods which they can safely apply in private work. I have never yet seen a case of ante-partum hæmorrhage plugged efficiently by a practitioner, and there can be no doubt that the application of the vaginal plug requires experience and skill. It is the duty of teachers who advocate reliance upon this method to ensure that every student who passes through their hands shall see this treatment carried out, and, if possible, personally assist in the application of the plug, otherwise they cannot do it properly. To teach midwives that they should plug the vagina is perfectly futile, for their scanty training does not in the least fit them to carry out such a method.

I also hope that, as an outcome of this discussion and of the afternoon discussion, it will be possible to formulate more definitely than has yet been done the conditions under which Cæsarean section should be resorted to in placenta prævia.

Dr. SYDNEY RUMBOLL (Leeds).

I have always followed the practice of the Dublin school in plugging the vagina—giving an anæsthetic; this enables one to clear up the vagina properly. I do not see, if medical students can be taught to do an aseptic operation, why they cannot be taught to plug a vagina antiseptically. I always impress upon my nurses that they are not to take upon themselves the responsibility of plugging, but they must call in a medical man. I have only required to perform Cæsarean section once, in a case of placenta prævia centralis, when hæmorrhage was profuse, and the os undilated.

Mr. GORDON LEY.

With regard to accidental hæmorrhage, I consider the cases should be divided into two groups, those in which bleeding is external—i.e., where contractions are present—and those where the bleeding is internal—i.e., the uterus is paralysed.

With regard to the first group, I do not think it matters very much what is done; the patient will deliver herself satisfactorily. In a series of fifty cases an account of which I read before this Section at the March meeting there were fifteen cases of this type. They were treated by plugging, by application of a tight binder and by pituitrin. The later cases in the series received less treatment than the earlier ones and I am rapidly coming to the conclusion that pituitrin alone is often the best treatment to employ.

With regard to the internal cases, these should be left entirely alone, a masterly inactivity being employed. The patient's general condition, her pulse-rate and the size of the uterus being carefully watched. If she improves and the uterus does not enlarge she should be left alone until pains start, when she can either be left to deliver herself or delivery can be assisted by any of the adjuvants mentioned above. If, however, she does not improve the case can only be satisfactorily treated by laparotomy. Cæsarean section should be performed and if necessary the uterus removed. This has been necessary in two cases I have seen owing to the inability to make the uterus contract. With regard to placenta prævia I have for a long time felt that external version followed by bringing down a leg is the ideal treatment and I have employed it in about 100 cases, almost without exception with absolute success; with a fœtal mortality of about 33 per cent. I have performed Cæsarean section only once for placenta prævia—a primigravida at the thirty-sixth week with the placenta apparently central. I can only conceive of Cæsarean section being the correct treatment in a case of a similar type and I heartily agree with what Dr. Spencer has said on this subject.

Dr. McKERRON (Aberdeen).

I was disappointed to find that, in introducing this discussion, Dr. Hastings Tweedy limited himself to one form of ante-partum hæmorrhage—accidental hæmorrhage—perhaps the most common but not, as a rule, the most serious form.

My experience of accidental hæmorrhage is limited largely to the lesser degrees which have been grouped by Sir William Smyly as comparatively trivial. I have never had occasion to use the vaginal plug; but from the results that have been obtained by this method, and still more from the evidence just adduced by Dr. Tweedy, I am convinced that the plug is a valuable method of treatment, and the best method for the general practitioner to employ. I always instruct my students in the use of the plug.

Of the other variety of ante-partum hæmorrhage my experience has been considerable. I do not know how it compares with the experience of others present, but I may say that I have treated at least 200 cases of placenta prævia, no fewer than nine since the beginning of this year. In these 200 cases there were only four maternal deaths, three of which occurred in one year—two in women who had repeated severe hæmorrhages, and were in a very precarious condition when admitted to hospital. One of them died, undelivered, about four hours after bipolar version. The third was a primigravida, with advanced heart disease, who was under treatment in hospital for failing compensation. She had a severe hæmorrhage—not excessive, but, in the circumstances, sufficient to preclude any chance of recovery. The fourth case was very disappointing. In inducing labour about two weeks before term for a minor degree of pelvic narrowing, a complete placenta prævia was discovered. De Ribes' bag was at once introduced, but labour pains did not begin till over forty-eight hours after. She died from sepsis a week after delivery.

As regards the children the results were, of course, not so satisfactory. Nearly 70 per cent. were stillborn or died within a few days. But in placenta prævia I agree with Sir Francis Champneys that attempts to save the child will be made at the expense of the mother, and that in placenta prævia the child must just take its chance.

In the treatment of placenta prævia the important essential is *early diagnosis*, followed by evacuation of the uterus in the safest possible way—for the mother. In hæmorrhage in the later months of pregnancy—in bleeding which suggests placenta prævia but where the diagnosis is doubtful—an examination should be made under an anæsthetic. I have frequently confirmed the diagnosis in doubtful cases in this way. The mortality in placenta prævia is more often the result not of the particular method of treatment adopted but of the delay in undertaking the necessary treatment—very often due to the delay in making a diagnosis. When the diagnosis is made, the uterus must be emptied as soon as possible — as soon as arrangements can conveniently be made. There is, I think, no disagreement on that point. But there is not quite the same unanimity as to what is the best method. My own preference is for bipolar version. I prefer version to de Ribes' bag where the os is sufficiently opened up or can be safely dilated digitally; and these conditions obtain in the vast majority of cases of placenta prævia. Where the os is rigid and the cervix not drawn up, a condition of matters very rare in placenta prævia, I introduce de Ribes' bag, if necessary securing the required dilatation by metal dilators.

Whichever method is used the expulsion of the child is left to nature. Post-partum hæmorrhage is said to be common in placenta prævia. Theoretically it should be, but I have not found it so. Where serious hæmorrhage does occur it is probably due to tearing of the cervix and lower uterine segment from rapid extraction.

A claim has been made for a more general adoption of Cæsarean section in the treatment of placenta prævia. In the interests of the child Cæsarean section may sometimes be advisable, but I have not, so far, seen a case in which in my opinion it would have been safer for the mother than the methods of treatment generally employed.

Professor MUNRO KERR (Glasgow).

In common with the other speakers, I regret that Dr. Hastings Tweedy has not made reference, in his most interesting introduction to the debate, to the other form of ante-partum hæmorrhage—namely, unavoidable hæmorrhage. Fortunately the treatment of this variety has been referred to by some of the previous speakers. One particularly interesting remark was that by Mr. Ley, who incidentally referred to the employment of external version. I wish to emphasize the importance of this method, and that it can be performed with ease in the great majority of cases. It has two great advantages: it lessens the risk of infection and disturbs the attachment of the placenta to a less extent, for with the breech brought over the os a limb can very easily be brought down. This contributes to a lower maternal and fœtal mortality. Another point is the advisability of not putting traction on the leg brought down, for if the labour is unduly hastened the child certainly suffers. The great advantage of Cæsarean section for this complication is that it very decidedly lessens the fœtal mortality, but in the meantime I do not think it advisable to employ the operation extensively, and prefer to limit it to the exceptional cases in which, owing to the age of the patient, the condition of the cervix and rigidity of the parts, delivery by the natural passage will be difficult.

As regards accidental hæmorrhage I entirely agree with Dr. Hastings Tweedy and consider the vaginal plug of very great value. I consider that a most important point has been made by Dr. Tweedy in that he has proved by his observations during Cæsarean section that plugging of the vagina actually compresses the uterine arteries, a claim which Dr. Hastings Tweedy has made for a number of years and which has been questioned by the majority of obstetricians. I think that if after a further investigation Dr. Hastings Tweedy's observations are confirmed he has established a very strong case indeed for plugging. In connexion with accidental hæmorrhage Mr. Ley's observations regarding the improvement that follows absolute rest, the administration of morphia and the use of small doses of pituitary extract, are of special interest. Undoubtedly it will be of great advantage if this latter treatment proves successful, for although plugging is most effective there is undoubtedly a considerable danger of infection where plugging is carried out in domestic practice and under conditions in which asepsis is difficult to establish. Rupture of the membranes in this condition is effective and sufficient whenever there is any uterine activity, and it is just possible that with rupture of the membranes and medium doses of pituitary extract plugging may become unnecessary. Naturally, therefore, if the former treatment proves less efficacious than plugging we must rely on the Dublin recommendation, so ably and graphically described by Dr. Hastings Tweedy. Should that be the case all students must be taught—and, indeed, whether it is the case or not all students must be taught—how to plug the uterus thoroughly and the means to be employed to prevent sepsis. This raises the whole question of the practical teaching of students which at present is so unsatisfactory.

The cases of accidental hæmorrhage in which Cæsarean section is necessary are few in number, but undoubtedly such cases do occur, and the patient can only be rescued by such a treatment. There is much to be said in favour of hysterectomy after Cæsarean section in such cases, and, in my opinion, it is advisable, for the uterine wall is generally so diseased by intramural hæmorrhage that a sound cicatrix is difficult to secure. If, however, it is deemed unadvisable to remove the uterus the patient should be sterilized and full doses of pituitary extract given to assist any post-partum hæmorrhage and relieve shock.

Professor HASTINGS TWEEDY (in reply).

It has been very gratifying to me to find how wide is the acceptance now accorded to the efficacy of the plug in accidental hæmorrhage. Dr. Fletcher Shaw and Dr. Fothergill object to it, not on the ground of want of efficiency but for the reason that its proper mode of application is not understood. This is purely a matter for more efficient education on the part of both doctors and nurses, and there is no possible excuse to be offered in mitigation of the offence of applying a dirty plug.

Mr. Gordon Ley's practice of leaving the bleeding to nature as long as he possibly can, will no doubt succeed in the vast majority of hæmorrhages, but it will inevitably result in an unnecessary loss in those cases which eventually have to be treated.

Dr. Blair Bell and Dr. Gordon Fitz-Gerald do not accept my explanation of the plug's action, but they have (as my friend Professor Munro Kerr has pointed out) failed to remember that I have directly demonstrated the stoppage of pulsation in the uterine artery.

Dr. Herbert Spencer inquired why the back of the hand is turned toward the pubes during the process of plugging. It is to force back the perinæum and relax the levator muscles. It will thus enable much more material to be placed in the vagina and promote the efficient ringing around of the cervix by the hard wet pledgets.

AFTERNOON SESSION.

(Adjourned Meeting.)

DISCUSSION ON RUPTURE OF THE CÆSAREAN SECTION SCAR IN SUBSEQUENT PREGNANCY OR LABOUR.

Mr. Eardley Holland.

My interest in this subject has been excited by the following series of events in the obstetrical department of the London Hospital. In November last I operated on a patient almost moribund from the effects of rupture of the scar of a Cæsarean section performed in 1915; in February of this year I saw in the post-mortem room a patient dead from abdominal sepsis consequent on rupture of the scar of a Cæsarean section I had myself performed in 1916, and in the years 1915 and 1916 three other of our Cæsarean section patients got rupture of their scars. The occurrence of five of these treacherous accidents in five years has made a very great impression on the minds of myself and my colleagues.

On inquiry into the subject I was impressed with the fact that we possessed very little information about rupture of the scar, either as to its causes, or, far more important, as to the frequency with which it occurred. At the outset I was struck by the wide divergence of opinion amongst the few with whom I talked or corresponded. On the one hand, I was told that rupture of the scar was more or less of a myth; on the other hand, I learned that certain outstanding surgeons, the Camerons, of Glasgow, for example, were so afraid of ruptured scars that their invariable custom was to sterilize their patients at the first operation. Further inquiry proved that rupture of the scar was no myth, but was a real menace; I heard of recent cases in London and elsewhere; about a hundred cases had already been reported in the obstetrical literature of Europe and America. Obviously the subject required investigation. It seemed, above all, imperative to find out what was the actual frequency, the real risk, of rupture. Quite apart from the importance of this information to obstetric surgeons, patients themselves might wish to know what sort of obstetric future they were likely to have after submitting themselves to Cæsarean section. It seemed all the more important to get exact information in view of the increasing frequency with which the operation is being performed; the scope of Cæsarean section has been widely extended of recent years, and its modern indications form an ever-growing list. There is another point: many patients who nowadays have had Cæsarean section have nothing to prevent them, in the event of a future pregnancy, from delivering themselves by the natural passages—a very different thing from the days when pelvic contraction was almost the only indication, when a repeated operation was the only way of future delivery, and when scars were seldom strained by labour.

If, on inquiry, the risk of scar rupture was revealed to be a negligible one, then we could, with clear consciences, go on advising and performing the operation according to its extended indications; but if the risk turned out to be an appreciable one, then we should be forced to seek safety either by limiting the indications or by contriving an operative technique which would give us a more dependable scar.

Impressed with the importance of these considerations, I determined to set about the subject and to arouse the interest and invite the co-operation of as many other obstetric surgeons as I could.

I have divided my paper into three sections:—

(I) An account of five new cases.

(II) An analysis of the literature, a general discussion on the ætiology and anatomy of ruptured scars, and an abstract of the cases hitherto reported.

(III) The results of a follow-up inquiry into the subsequent obstetric history of a large number of Cæsarean section patients, operated on between 1912 and 1918 inclusive.

(I) AN ACCOUNT OF FIVE NEW CASES.

The details of the five new cases from the London Hospital are as follows:—

Case I.—Reg. No. 1914 41137. Cæsarean section on April 17, 1914, by Dr. Russell Andrews. Primigravida, aged 29; lumbar kyphosis, with extreme contraction of the pelvic outlet. Entered hospital early in labour at term; uterus opened by usual anterior median incision; sutured with two layers of chromic catgut, a deep buried one including the whole thickness of the muscle and missing the endometrium, and a continuous peritoneal suture. Placental site not noted. Living child, weight 6¾ lb. Recovery good; the temperature did not rise above 99·4° F. during the first four days, and afterwards was not above normal.

Readmitted on August 13, 1915, with rupture of the scar. No intervening pregnancy. Last menstrual period, November 11, 1914. Pain began on August 13, 1915, at 2.30 a.m., when she got out of bed to attend to her child, who was screaming; it was a continuous cramping pain which doubled her up and made her vomit and feel faint; it was stated that she fainted several times. She was admitted at 8 a.m.; anæmic, pulse 120 and of poor volume, temperature 98° F. She was in continuous abdominal pain, the uterus was very tender and hard and the abdominal muscles rigid; the fœtal heart could not be heard; no external hæmorrhage. A diagnosis of concealed accidental hæmorrhage was made. There were no labour pains. Laparotomy by the late Dr. Drummond Maxwell. An ovoid rupture, 1½ in. long, was seen in the upper part of the uterine scar, the rest of which was faintly visible as a linear peritoneal thickening. Placental tissue protruded through the rupture, and blood was oozing from it. There were about 2 pints of blood in the peritoneal cavity. The uterus, with the ovum *in situ*, was removed by subtotal hysterectomy, and the patient made a good recovery.

The specimen is, unfortunately, not available for descriptive purposes.

Case II.—Reg. No. 1914/42248. July 26, 1914. Primigravida, aged 19; admitted with eclampsia, in the thirty-eighth week of pregnancy. Before admission had already had five convulsions; between 5 a.m. and 11.30 a.m. had convulsions every half hour; treated with morphia, venesection and intravenous saline infusion. After temporary improvement, the convulsions increased in severity and frequency. At 2.30 p.m. Cæsarean section was performed by Mr. Gordon Luker. Labour had already started. The uterus was opened by the usual anterior median incision. Recently dead fœtus, of 7½ lb weight, delivered. Incision sutured with two layers of chromic catgut, deep and superficial. Convalescence was febrile; the temperature rose daily to 102° F. for the first four days, for the next five it did not exceed 100° F., on the tenth and eleventh it rose to 103° F.; on the twelfth it fell to 99° F., and remained between 99° F. and normal until the patient was discharged, well, on August 16, 1914. The abdominal wound healed by primary union.

Readmitted on November 19, 1915, in a state of collapse in the eighth month of her second pregnancy. Laparotomy by Dr. Drummond Maxwell: the dead fœtus and much blood lay in the peritoneal cavity. There was a rupture through the scar of the former Cæsarean section; the placenta lay almost completely outside the uterus, but still attached to one side of the rent. The uterus was removed by subtotal hysterectomy, but the patient died shortly afterwards.

Description of the Uterus.—A uterus removed by amputation through the cervix, with a long, widely-gaping rupture through its anterior wall. Outside

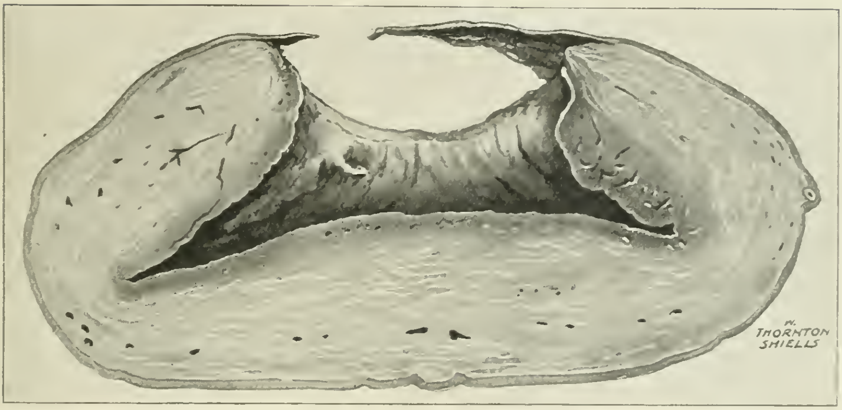

FIG. 1 (Case II.)

Drawing of section through upper third of uterus. Note: (1) Broad rounded edges of ununited muscle; (2) the decidua covers these edges and reaches almost to the peritoneum; (3) the narrow band of tissue between peritoneum and decidua on the right side, through which rupture has occurred; (4) the overhanging flap of wide thin scar area, consisting of little else than peritoneum.

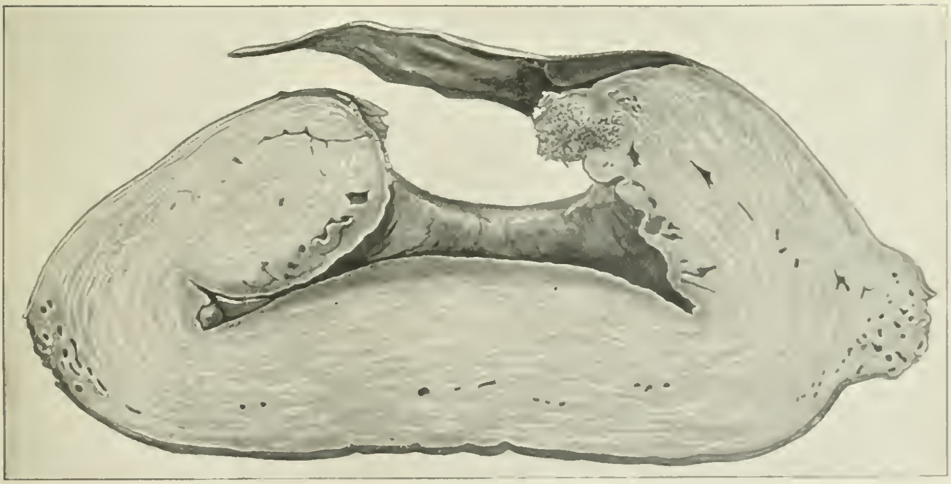

FIG. 2 (Case II.)

Drawing through middle of uterus. Note, in addition to points in fig. 1: (1) Insertion of a piece of placenta into left edge of ununited-muscle edge; (2) subperitoneal hæmatoma; (3) the broad thin scar area has torn through at one edge and not along its middle.

measurements of uterus: Length, 14·5 cm.; greatest width, 14 cm. Uterine cavity: length, 13 cm. Measurements of rupture: Length, 10·5 cm.; width at upper end, 7 cm.; at lower end, 5 cm. Thickness of uterine wall at edges of rupture, 2 cm. near the upper end, decreasing to 1·5 cm. near lower end. Continuous with the lower angle of the rupture is a linear thinned area in the uterine wall, 2·5 cm. long. This is the unruptured part of the scar and is only 0·5 cm. thick. The edges of the uterine wall at the site of rupture are for the most part rounded and smooth. At first sight the impression obtained is that the whole thickness of the uterine wall had been torn through, but closer inspection shows that the decidual lining of the uterine cavity is continued up over these rounded edges, and reaches in most places very close to the torn peritoneum (*see* fig. 1); at the upper and lower ends of the ruptured area, decidua and peritoneum almost meet. The irregularly torn peritoneal layer overhangs very liberally the thick, decidua-covered edges (fig. 2); in places the peritoneum is thickened by an underlying thin fibrous tissue layer. In the middle two-thirds, on both sides, is a well-defined subperitoneal hæmatoma, extending laterally and stripping the peritoneum for some distance from the underlying uterine wall. Firmly adherent to the middle third of the whole thickness of the left edge of the ruptured area is a piece of placenta, covered by loosened peritoneum and a subperitoneal hæmatoma (*see* fig. 2). On the opposite edge the decidual layer is absent, and is replaced by a roughened area covered with broken laminæ of clot; this evidently represents part of the placental site. There are the remains of many thick omental adhesions to the peritoneum over the ruptured area. These findings are to be interpreted as follows: (1) The real scar, through which the rupture occurred, is extremely thin, and consists of little more than stretched peritoneum with here and there a thin layer of fibrous tissue. In its original state, before rupture, no doubt this thin peritoneal scar was covered beneath with decidua. (2) The thick edges of the ruptured area are the ununited muscle wall of the uterus, covered with decidua, except where they enter into the placental site. (3) The placenta was inserted over the scar and into the thick ununited muscle edges. (4) Retroplacental hæmorrhage probably occurred beneath the stretched scar before rupture occurred; in fact, retroplacental hæmorrhage may have been the determining cause of rupture.

Case III.—Reg. No. 1914/40909. Cæsarean section on March 26, 1914, by Dr. Russell Andrews. Patient, aged 28, with flat rickety pelvis, and other skeletal changes, including bowing of the femora, tibiæ and ulnæ. Two former full term labours: (1) 1911, instrumental dead birth; (2) 1912, instrumental live birth. Last menstrual period, August 14, 1913. Admitted to the hospital in thirty-second week of pregnancy, on March 26, 1914, having been eighteen hours in labour; os uteri two-fifths dilated, membranes intact, transverse presentation. After external cephalic version the head was found too large to enter the pelvic brim. Cæsarean section performed; uterus opened by usual anterior median incision; sutured with two layers of chromic catgut, a deep buried one including the whole thickness of the muscle and missing the endometrium, and a continuous Lembert peritoneal suture. Placental site not noted. Child alive, weight 5¼ lb. The convalescence was febrile, the temperature rising daily for thirteen days after operation to 100° or 101° F.

Readmitted, early in her fourth labour, on March 16, 1916, calculated to be thirty-two weeks pregnant. Labour pains began at 2.30 p.m., and were of moderate strength. At 6 p.m. spontaneous rupture of the uterus occured, accompanied by the usual signs of collapse, pronounced anæmia, cessation of labour pains, and distinctive feeling of the fœtus beneath the abdominal wall. Immediate laparotomy; the dead fœtus, placenta and much blood were in the peritoneal cavity. The scar was ruptured in its entire length; uterus removed by subtotal hysterectomy. Next day the patient got left hemiplegia, but ultimately made a good recovery from the operation.

The specimen is not available for examination, and it is not known whether the placenta was implanted over the scar or not.

Case IV.—Reg. No. 1914 42939. A case of pronounced rickety flat pelvis, with stunted stature and other skeletal changes, including bowing of the femora and tibiæ. Preceding obstetrical history: (1) Instrumental labour at term, dead birth; (2) instrumental labour at term, child lived a few hours: (3) instrumental labour at term, dead birth. In her fourth labour at term the patient was admitted under the care of the late Dr. Drummond Maxwell on October 11, 1914, and was delivered by Cæsarean section. The usual anterior median incision was made in the uterus, and it was sutured with two layers, deep and superficial, of chromic catgut. Child alive, weight 6½ lb. Convalescence febrile; the temperature rose to 102·8° F. on the second day, and varied between 100° and 103° F. until the seventh day, after which it gradually fell. Placental site not recorded.

Readmitted in her fifth labour, at term, in 1916. Head was engaged in pelvic brim; forceps applied, and a healthy child of 7 lb. delivered. Puerperium febrile; temperature gradually rose to 103° F. on the fourth day, fell by lysis, and reached normal on the ninth day.

Readmitted in her sixth pregnancy, with rupture of the uterus, on August 8, 1919. She had last menstruated on December 1, 1918, and was in regular attendance at the ante-natal department. At 12 o'clock, midday, whilst sitting in a chair, she suddenly got intense abdominal pain, which made her feel very faint. The pain persisted, and as she appeared obviously very ill, her friends summoned assistance at 3 p.m. When the midwifery assistant arrived he found her sitting propped up in a chair and in the last stages of collapse. She was immediately transported to the hospital in an ambulance. On arrival, she was profoundly anæmic, and collapsed; abdomen distended and extremely tender all over; fœtus felt with remarkable distinctness, and what was surmised to be the empty uterus was felt reaching up to the umbilicus. Immediate operation by Mr. Eardley Holland, under stovaine spinal anæsthesia. The dead fœtus, together with a large quantity of blood and many recent clots, was found free in the peritoneal cavity. The placenta was almost completely separated and lying just outside a large gaping rent in the anterior wall of the uterus, a very small part of it being still attached near the left edge of the rupture. After removing the fœtus and placenta, attention was turned to the uterus, which was rigidly contracted and anæmic, and a long, widely-gaping rupture occupied almost the whole length of its anterior wall. The rupture looked like a clean tear, except at its upper and lower ends, where it had extended laterally to a slight extent. Its edges were thick and smooth, giving the false impression that the rupture had occurred through the entire thickness of the uterine wall. Projecting from the thick edge of one side was a ragged leaf of thickened peritoneum, about 1 cm. wide. This was in reality the stretched scar, and it had ruptured, not along its middle, but along its junction with the opposite thick edge. There had been a complete failure of muscular union, and the ununited muscle formed the two thick edges. The rupture was rapidly closed with a single layer of interrupted sutures of No. 3 silk, placed about ½ cm. apart, and including the whole thickness of the uterine wall except the endometrium. The patient made an excellent recovery; for the first week the evening temperature rose to 100° F., but there was no other trouble. She was last seen in excellent health on February 1, 1920; the management of a future pregnancy will be a problem (but refer to case abstract No. 87).

Case V.—Reg. No. 1917/40655. Cæsarean section on February 26, 1917, by Mr. Eardley Holland. Primigravida, aged 20; admitted with eclampsia, in the thirty-sixth week of pregnancy. Had three convulsions before admission, was comatose, and the urine, on boiling, was solid with albumin; cervix intact, no labour pains, fœtal heart heard. Cæsarean section under stovaine spinal anæsthesia; uterus opened by anterior median incision, fœtus dead, placenta posterior. Incision closed with No. 3 interrupted silk sutures, placed about ½ cm. apart, and including the whole thickness of the uterine wall except the endometrium; this layer was covered with a continuous peritoneal suture. Convalescence febrile; temperature ranged between 100° and 102·6° F. for first seven days, and lochia was offensive. The abdominal wound healed by primary union.

During her second pregnancy she was a regular attendant at the antenatal department. Last period, May 28, 1919; urine never contained albumin, and health excellent. She was admitted again on January 17, 1920, with severe puerperal sepsis, following premature confinement. Only an imperfect history of her confinement and illness could be obtained. Labour was completed in a few hours, on January 11, 1920; the placenta was retained, and was removed manually, with some difficulty, two hours after the birth of the child, which lived only a few hours. The following day she got abdominal pain and dyspnœa, and was sent into the hospital. On admission into the septicæmia ward on January 17, 1920, she was extremely ill: temperature 104° F., pulse 120, abdomen rigid and tender, constant diarrhœa. She was considered to have puerperal septicæmia, but blood cultures taken on different occasions were sterile. The perineum was completely ruptured into the rectum. For a fortnight she held her ground, and even improved slightly in her general condition. Abdominal section was considered and rejected. In the light of what was found post mortem, I am bound to admit that if the true condition of affairs had been suspected and her abdomen opened, her life might have been saved. The discharge from her uterus became more and more offensive, and was undoubtedly fæcal in character. She died on February 16, 1920.

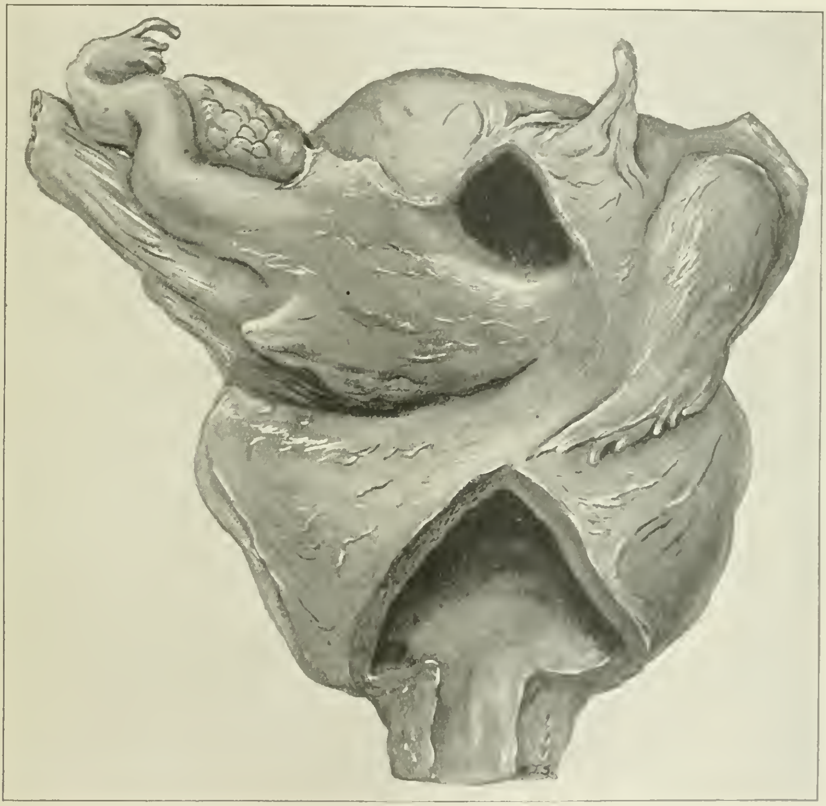

Fig. 3 (Case V.)

Puerperal uterus, tubes, ovaries and bladder; bladder and urethra have been laid open. On anterior surface of uterus is a rupture through the lower two-thirds of a Cæsarean section scar. Left half of utero-vesical pouch obliterated by adhesions; right half of the pouch was the site of an abscess cavity, with fæcal contents, communicating both with the uterine cavity through the rupture, and with a perforation in an adherent coil of small intestine.

A post-mortem examination was made, and I am indebted to Professor Turnbull for the following notes: General purulent peritonitis, with localized abscesses. Fibrous peritoneal adhesions at fundus of uterus, between bladder, uterus, and small and large intestines. Pus tracking up right and left sides of abdominal cavity. Localized subdiaphragmatic abscess in antero-superior surface of the right lobe of the liver, close to the falciform ligament. Perforation, 1 cm. in diameter, in wall of small intestine, 240 cm. below the duodeno-jejunal flexure. Dense fibrous peritoneal adhesions with pus pockets between the lower coils of small intestine and uterus. Diphtheroid inflammation with slight scarring of vagina. Dilated cervix uteri admitting two fingers. Rounded perforation, 3 cm. by 2 cm., on anterior wall of fundus of uterus. Dirty green diphtheroid inflammation of endometrium. Dilatation with purulent content in left Fallopian tube. Small amount of pus in right Fallopian tube. No thrombi in uterine or ovarian veins. Small empyema between right middle and lower lobes and the diaphragm, the result of spread of infection from subdiaphragmatic abscess. The pelvic viscera were removed *en masse*, and show the following details (*see* fig. 3): Uterine cavity, 7 cm. long, 4 cm. laterally, and 4 cm. antero-posteriorly. The rupture measures 3 cm. by 2 cm., with rounded and smooth edges; the right edge is 1·5 cm. thick and the left 0·5 cm. The edge at the upper angle of the rupture is thin (0·5 cm.), where it is continued into the unruptured part of the scar. The unruptured part, which can be seen and felt as a thin furrow on the inner surface of the anterior wall, measures 1·8 cm. long; it is not visible on the outer surface, as it is covered by adhesions. The scar had, therefore, ruptured in its lower two-thirds. There are the remains of many old firm adhesions over the anterior surface and fundus of the uterus, one particularly broad and firm, one covering the unruptured part of the scar. The left half of the utero-vesical pouch of peritoneum is obliterated by dense adhesions between the bladder and the uterus; to the right of the midline it was occupied by an abscess cavity, with fæcal contents. This abscess communicated with the already-mentioned tear or perforation in the small intestine and with the uterine cavity, through the rupture. Thus, there had been a utero-intestinal fistula.

Whether the intestine was injured at the time the rupture occurred, or whether the perforation arose subsequently cannot be said for certain. I favour the former view.

A point of special interest in this case is whether the scar ruptured spontaneously during labour, or whether it was ruptured during the difficult manual removal of the placenta. In the light of other reported cases I am inclined to think it ruptured during labour, and that the retention of the placenta, as well as the difficulty of its removal, was due to its partial escape into the peritoneal cavity.

(II) ON THE ÆTIOLOGY AND PATHOLOGY OF RUPTURED SCARS, WITH ANALYSIS OF REPORTED CASES AND CRITICAL REVIEW OF THE LITERATURE.

I have found accounts of ninety-two cases, reported in sufficient detail to make them worth collective study, and have made a short abstract of the essential facts of each case. These have been got direct from the original source, with the very few exceptions where the original accounts were not accessible and I had to rely on abstracts made by others. I have omitted a few cases to which I found references, but of which I could neither get at the original report nor find reliable abstracts. It is obvious, too, that many cases have never been published at all; speakers in discussions before Societies on the subject of ruptured scars often refer to such cases, personal or otherwise. Up to a point, references to cases were not hard to find, and I am indebted to other writers who have published collections of cases, especially to L. Singer, (1909), Albert Wyss (1912), Palmer Findley (1916), and E. Schroeder (1916).

The classical operation dates from 1882, when Sänger and others published their improved suture methods. I need hardly state that I have not included cases of ruptured scar following the operation of pre-suture days: one half of the minority who survived this operation got a ruptured scar in the unfortunate event of a future pregnancy. The first case in my list, Koblank's, occurred in 1891, and more than two-thirds have been reported since 1910, coinciding with the period when the indications for Cæsarean section began to be extended.

In each case abstract the following essential points are noted: Age, parity. At Cæsarean section: Indication, uterine incision, placental site, suture material, recovery afebrile or otherwise. Number of Cæsarean sections, labours intervening between Cæsarean section and rupture. At rupture: Interval since Cæsarean section, period of pregnancy, in labour or not, placental site, peculiarities in symptoms or their onset, accidental factors, extent of rupture, treatment, result to mother and child. Unfortunately, all cases are not reported in full detail; but, amongst the sum of the cases the data are in sufficient number to indicate the chief factors favouring rupture of the scar. The case abstracts will be found at the end of the paper, numbered and with their references. I have isolated the essential points of these ninety-two reported cases, and of my own five, in the following summary, so that the extent to which each one occurs can be conveniently noted, and its individual importance estimated.

Parity.

Rupture occurred in the second pregnancy	in 54 cases
,, ,, third ,,	,, 19 ,,
,, ,, fourth ,,	,, 10 ,,
,, ,, fifth ,,	,, 6 ,,
,, ,, sixth ,,	,, 3 ,,
,, ,, eighth ,,	,, 1 ,,
Number of preceding pregnancies not mentioned	,, 4 ,,

Indications for Cæsarean Section.

Contracted pelvis	in 64 cases
Eclampsia	,, 12 ,,
"Nephritis"	,, 1 ,,
Albuminuria of pregnancy	,, 1 ,,
Dermoid cyst of ovary	,, 2 ,,
Fibromyoma of uterus	,, 1 ,,
Hæmatoma of vagina and vulva	,, 1 ,,
Sacral tumour	,, 1 ,,
Stricture of cervix	,, 1 ,,
Vaginal varices	,, 1 ,,
Shoulder presentation	,, 1 ,,
Concealed accidental hæmorrhage	,, 1 ,,
Indication not mentioned	,, 10 ,,

The Cæsarean Section Incision.

Anterior median	in 54 cases
Posterior median	,, 1 ,,
Transverse fundal	,, 28 ,,
Anterior median and transverse fundal	,, 1 ,,
Cervical	,, 1 ,,
Site of incision not mentioned	,, 12 ,,

Relation of Incision to Placental site at Cæsarean Section.

Incision through placental site	in 10 cases
Incision not through placental site	,, 6 ,,
Placental site not mentioned	,, 81 ,,

Suture Material.

Catgut	in 41 cases
Silk, often with continuous catgut for the peritoneum	,, 12 ,,
Reindeer tendon	,, 1 ,,
Suture material not mentioned	,, 43 ,,

Fever or Sepsis during recovery from Cæsarean Section.

Recovery febrile, or abdominal or uterine infection	in 51 cases
Recovery stated to be afebrile	,, 15 ,,
No details mentioned	,, 31 ,,
Cases with afebrile recovery are	Nos, 11, 12, 16, 17, 20, 22, 27, 41, 42, 43, 58, 81, 82, 84 and 93

Interval between Cæsarean Section and Rupture.

Less than one year	in 2 cases
One year	,, 12 ,,
Two years	,, 25 ,,
Three years	,, 21 ,,
Four years	,, 13 ,,
Five years	,, 3 ,,
Six years	,, 3 ,,
More than six years (including one of eleven and one of twelve)	,, 4 ,,
Interval not stated	,, 14 ,,

Number of Cæsarean Sections preceding Rupture.

One	in 88 cases
Two	,, 6 ,,
Three	,, 2 ,,
Number not mentioned	,, 1 ,,

Number of Labours intervening between Cæsarean Section and Rupture.

None	in 85 cases
One	,, 8 ,,
Not stated	,, 4 ,,

The numbers of the cases in which an intervening labour is reported are as follows: ... ... Nos. 17, 19, 30, 40, 43, 59, 64, 96

Period of Pregnancy at which Rupture Occurred.

Term	in 47 cases
Near term	,, 6 ,,
8½ months	,, 1 ,,
8 ,,	,, 10 ,,
7½ ,,	,, 1 ,,
7 ,, (Nos. 2, 22, 53, 65, 70, 88, 90)	,, 8 ,,
4, and again at 7 months (No. 34)	,, 1 ,,
38 weeks	,, 3 ,,
37 ,,	,, 2 ,,
36 ,,	,, 4 ,,
32 ,, (Nos. 77, 95)	,, 2 ,,
"Early pregnancy" (No. 15)	,, 1 ,,
Eleven months, post mature (No. 48)	,, 1 ,,
Period not stated	,, 10 ,,

Whether Rupture occurred during Labour or during Pregnancy before the onset of Labour.

In labour	in 19 cases
In labour, early in first stage	,, 29 ,,
During pregnancy, before the onset of labour	,, 36 ,,
No details given	,, 13 ,,

Relation of Placenta to Scar at time of Rupture.

Placenta implanted over scar	in 34 cases
Placenta not implanted over scar	,, 17 ,,
Placental site not mentioned	,, 46 ,,

Accidental Factors likely to have been Exciting Cause of Rupture.

None mentioned	in 80 cases
Nos. 20 and 35, Hydramnios	,, 2 ,,
,, 3, Twins and hydramnios	,, 1 ,,
,, 26 and 43, Version	,, 2 ,,
,, 59 and 61, Induction and version	,, 2 ,,
,, 88, Accidental hæmorrhage	,, 1 ,,
,, 14, Accident	,, 1 ,,
,, 30, Difficult breech labour	,, 1 ,,
,, 48, Post mature fœtus	,, 1 ,,
,, 55, Fœtus excessively large	,, 1 ,,
,, 65, Placenta prævia, hydrostatic bag	,, 1 ,,
,, 74, Pituitrin	,, 1 ,,
,, 84, Pituitrin and obstructed breech labour	,, 1 ,,
,, 97, Manual removal of placenta	,, 1 ,,
,, 19, Long labour, with contracted pelvis	,, 1 ,,

Extent of Rupture.

Rupture of entire or almost entire length of scar	in 67 cases
Rupture of small portion only of scar	,, 22 ,,
Extent not mentioned	,, 8 ,,

(Small perforation only in Nos. 19, 21, 24, 28, 33, 38, 41, 47, 49, 50, 56, 66, 70, 71, 78, 81, 82, 83, 84, 90, 93, 97)

Treatment of the Rupture.

Hysterectomy, subtotal	in 56 cases
Vaginal hysterectomy	,, 2 ,,
Suture, sometimes with excision of edges	,, 26 ,,
Drainage	,, 2 ,,
Treatment not stated	,, 1 ,,
Death before operative treatment	,, 10 ,,

Result to Mother.

Lived	in 66 cases
Died	,, 28 ,,
Not mentioned	,, 3 ,,

Result to Child.

Dead	in 69 cases
Lived	,, 21 ,,
Not mentioned	,, 7 ,,

On the Anatomy of the Uterine Scar.

(A) *Perfectly Healed Scars.*—Perfect healing of the uterine incision may result in complete muscular regeneration, leaving no trace of scar tissue except on the peritoneal surface. Whitridge Williams has studied the cicatrix in ten uteri, removed by Cæsarean hysterectomy, which had been subjected to Cæsarean section upon one or more previous occasions. In eight of his specimens (one of which had been subjected to two, and another to three previous Cæsarean sections) it was difficult to find the old cicatrix by examination with the naked eye; the only indication of its existence was the presence of slight vertical depressions upon the external and internal surfaces of the uterus. Microscopical examination revealed the entire absence of scar tissue in the uterine wall, and showed the muscle fibres extending across the site of the old incision as if it had never existed. It is interesting to note that the convalescence from the previous operations had been uncomplicated. In another specimen, deep furrows existed on the external and internal surfaces of the uterus, the two being separated by a band of tissue 3 mm. thick, in contrast to the adjacent uterine walls which measured 2·5 cm. in thickness. The external furrow was covered with peritoneum, and the internal was lined with typical decidua; the intervening tissue was normal muscle, showing no trace of scar tissue, and differing from the normal only by its thinness. The history of this patient was that the convalescence had been stormy. Jolly, in his case (abstract No. 50), describes perfect muscular regeneration in the unruptured part of the scar.

(*B*) *Thin Scars*.—Light is thrown on the causes and anatomy of ruptured scars by studying scars that are thin, for it is only thin scars that are likely to rupture. A thin scar becomes progressively stretched and thinned during pregnancy, owing to the increasing distension of the uterus. Thinning of the scar, as found at a repeated Cæsarean section, or in a uterus removed for some reason from a patient who has formerly had a Cæsarean section, is not at all uncommon; every obstetric surgeon of experience has encountered it. Harrar, at the New York Lying-in Hospital, found that in fifty instances of the repeated operation, in forty-two the old scar was either not found at all, or, if found, was solid; in four there was marked attenuation, in two there was partial rupture at the location of the old scar, and in two there was complete rupture. Van Leuwen collected all cases of repeated operation reported in literature down to 1903, and found thin scars reported in twenty out of 117 cases. These figures probably represent cases of extreme thinning only; a moderate degree of thinning, or extreme thinning of a small portion of the scar is, in my experience, much commoner than this, if looked for by palpating the whole length of the scar, after the uterus has been emptied, between a finger within and a finger without the uterus. By various writers these wide thin scar areas, as found at repeated operations, have been described as "thin as paper, only 1 to 2 mm. thick," and have sometimes been mistaken for the bulging amnion herniated through the scar. Sometimes a subperitoneal hæmatoma has been observed, an indication of imminent rupture. There are, of course, varying degrees of thinning of the scar. Sometimes it is extreme, sometimes moderate: sometimes the entire length of the scar is affected, sometimes only a part. The only case I have found recorded in which the thin scar consisted of normal muscle is that of Whitridge Williams, to which I have already referred. In all others it was composed of scar tissue, often with a varying proportion of muscle fibres scattered through it. In my own second case the unruptured part of the scar consists almost entirely of scar tissue, but muscle fibres, singly or in groups, are scattered through it, and have even grown right across its whole width. In cases of extreme thinning the attenuated scar area consists merely of peritoneum in contact with decidua, with a few intervening strands of fibrous tissue. These attenuated peritoneo-decidual scars are just the scars liable to rupture during pregnancy or labour from a rise of intra-uterine pressure. The point of greatest importance about these scars is that the uterine muscle has completely failed to unite: the sutures employed to close the incision either slough out or cut out, and the muscle surfaces retract, and become widely separated. The peritoneum, on the contrary, holds firm. The retracted muscle surfaces later become smooth and rounded, and in course of time covered by a layer of endometrium, which, in a subsequent pregnancy, is converted into decidua. The endometrium grows also across the line of the scar beneath the peritoneum, and covers the inner surface of the gap. Further thinning of this peritoneo-decidual scar is the natural sequence of the distension of the uterus during pregnancy. The analogy between such a scar and a defective abdominal scar is irresistible; the one consists of peritoneum and decidua, and the other of peritoneum and skin; in both the muscle is wanting. In some cases even peritoneal union has been demonstrated to have failed in parts of the scar, and the gaps have been plugged by adherent omentum or bowel. Excellent histological studies of thin scars have been published by Couvelaire, Offermann, Spalding and others.

(*C*) *Ruptured Scars.*—Good anatomical and histological descriptions of the ruptured scar are given in the case abstracts, Nos. 2, 11, 16, 17, 20, 27, 31, 32, 33, 35, 43, 46, 50, 55, 56, 60, 72, 73, 80, 82 and 84. There is no doubt that when the scar has ruptured it has nearly always been one of the thin scars I have described in the foregoing section.

The peritoneo-decidual scar has gradually been converted into a widely stretched area, during the progressive uterine distension. When this thin area ruptures it has usually been noticed that the line of rupture does not occur along its middle, but at the sides, near the thick part of the uterine wall. A thick, or even a moderately thick scar, whether composed of fibrous or muscular tissue or both, does not rupture except under extreme provocation, such as obstructed labour. The appearance of a ruptured scar, after the uterine contents have escaped, and retraction has occurred, is deceptive, and has, in the earlier observed cases, led to wrong descriptions and tortuous explanations. The deceptive feature is the thickness of the edges of the ruptured area. These edges, as already pointed out, consist of the ununited muscle surface covered with decidua. After the uterus is emptied and retracted these muscle edges become extremely thick—equal in thickness indeed to the rest of the uterine wall. Furthermore, these thick edges, since chorion or placenta has been separated from off them, are either found oozing blood or covered with pieces of blood clot. In fact, their appearance is almost exactly as if the whole thickness of the uterine wall had been newly torn through, whereas in reality it is only the stretched deciduo-peritoneal area that has given way. The true state of affairs is illustrated in figs. 1 and 2, where the decidua can be followed from the uterine cavity over the ununited muscle edges almost up to the ruptured peritoneal coat. In my own fourth case, where I sutured the rupture, I believed I was suturing thick recently ruptured surfaces ; it is only in the light of the experience from my second case, and of cases reported in the literature, that I now realize I sutured together the old ununited muscle surfaces.

It is interesting to note that for many years the true significance of the decidual covering to the muscle surfaces was missed ; it was supposed that during pregnancy decidual cells grew up through the scar to the peritoneum, weakening the scar and making it liable to rupture (refer to case abstract No. 16).

Liability of Uterine Incision to yield shortly after Operation.

It is not often that Cæsarean section cases come to post-mortem, and it is even rarer for a case to be reopened for hæmorrhage or sepsis. In such cases it is surprising how often there has been observed a yielding of the incision from the loosening or cutting through of the sutures. Wyss has made a small collection of these. Scheffzek reports having seen two post-mortems after Cæsarean section, in which the catgut sutures had become completely unknotted. Boissard reports the case of a patient who died from sepsis on the fifth day; four of the interrupted catgut sutures had become untied and the incision gaped widely, there was intraperitoneal hæmorrhage and the uterine cavity was filled with blood clot. Cristalli reports a case in which, because of severe and persistent hæmorrhage following Cæsarean section, subtotal hysterectomy was performed; a gap was found in the line of uterine incision, which had been sutured with silk. Le Page reports a somewhat similar case, in which the uterus had been sutured with catgut. One is led to believe that this accident may sometimes happen in cases that recover; they would not necessarily pass through a stormy convalescence, for such an accident, without sepsis or with only local sepsis, should not produce much disturbance. The partially or completely gaping scar would quickly be sealed or plugged by omentum. It is quite probable that the firm adhesion of omentum to the old scar, so commonly found in cases of repeated Cæsarean section or subsequent rupture, may represent the same protective plug.

Utero-abdominal Fistula.

This is not a great rarity, following infection of the uterine and abdominal wounds; it may persist for many months. The uterine scar, in such cases, is bound to be extremely defective and liable to rupture in the event of subsequent pregnancy. Amongst the case abstracts, utero-abdominal fistula will be found noted in Nos. 14, 32, 34, 45 and 51. Case No. 34 is peculiar: at the fourth month threatened abortion resulted in partial rupture of the scar and the formation of a utero-abdominal fistula through which a piece of intestine could be seen adherent to the scar; at the seventh month a more extensive rupture occurred, resulting in death of the patient in spite of operation.

If, accompanying the fistula, the uterine scar is completely adherent to the abdominal wall, subsequent rupture may be entirely extraperitoneal. An interesting example of this is recorded by Noble (not placed amongst the list of ruptured scars). A utero-abdominal fistula persisted after the first Cæsarean section; another pregnancy soon followed and the liquor amnii escaped through the fistula in the thirty-third week. The second Cæsarean section was performed by enlarging the fistulous opening; the uterine scar was found completely adherent to the abdominal wall, and the operation was entirely an extraperitoneal one.

On the Site of the Uterine Incision and Subsequent Rupture.

On referring to the summary of reported cases it will be noted that, in the eighty-five cases where the site of incision was stated, the classical incision was employed fifty-five times, the transverse fundal incision twenty-eight times, and the cervical incision only once. There is no doubt that the transverse fundal incision, introduced by Fritsch in 1897, is specially liable to rupture. Ekstein (abstract No. 50), reported the first case of ruptured fundal scar in 1904. The number of ruptures after the transverse fundal incision compared with the number after the classical operation is relatively very high, considering how late it was introduced, and how relatively few must be the number of Cæsarean sections in which this incision was employed. Two points theoretically favour rupture of transverse fundal scars; one is that most of the muscle bundles are cut at right angles, and the incision therefore tends to gape widely, favouring imperfect union; the other is that the fundus is the part of the uterus which is relatively most distended during pregnancy, and, in consequence, a fundal scar will be relatively more stretched than the scar of the classical operation. There have been comparatively few reports of the successful termination of pregnancy and labour after the transverse fundal incision. This incision is, in fact, to be avoided because of its liability to rupture.

The incision that at present holds the best record for immunity from rupture is the cervical (by this I mean the transperitoneal or extraperitoneal cervical operations, of which, as is well known, there are many varieties). All the same, before this incision is lauded because of its apparent immunity from rupture, it must be remembered that very few cervical Cæsarean sections have, up to now, been performed, compared to the thousands of classical and transverse fundal Cæsarean sections; it still has to stand the test of time.

The cervical incision was first employed by Frank in 1906. It was at once pointed out by the theorists that the cervical scar would be specially prone to rupture; it lay in that part of the uterus most subjected to stretching during labour, and, being placed nearer the contaminated area, (i.e., the vulvo-vaginal tract) would therefore be more liable to infection. These fears of rupture have not been fulfilled; only one case has been reported (abstract No. 72) and only a small number of thin cervical scars have been observed, in spite of the fact that many cases of subsequent pregnancy have occurred. There seem to be excellent reasons for the sound healing of cervical scars, and for their resistance to rupture. Rest is an essential to good union of divided muscles; a state of rest or immobility is impossible in the body of the puerperal uterus, where contractions and relaxations are constantly tending to disturb the apposed surfaces and draw the healing muscle fibres apart; all operators are aware of the great lateral tension on the sutures, and of the tendency of the incision to gape during a strong contraction. On the other hand, the cervical incision is situated in a quiet part of the uterus which does not undergo contractions and relaxations. In Frank's original operation he incised the cervix transversely; this has now been generally replaced by a longitudinal incision. Mechanically, the stretching and rupture of the tranverse scar would seem more likely, because its line lies at right angles to the direction of the chief pull of the uterine muscle fibres; whereas the longitudinal scar lies in the line of the pull, and its edges have scarcely any tendency to be drawn apart.

As regards the reported case of rupture of a cervical scar, (abstract No. 72) it is only fair to state that at the Cæsarean section the cervical incision had to be prolonged for a short distance upwards into the body of the uterus in order to give more room for the fœtus, and it is quite possible that the rupture started in this part of the scar.

Some reports on thinning of the cervical scar are the following: Traugott reports a case where the first Cæsarean section was a Frank's cervical one, done for contracted pelvis. The next pregnancy was a placenta prævia, in the eighth month, with natural delivery; the third time, at term, another cervical Cæsarean section was done. The cervical wall, in the region of the old incision, was thinned out to a membrane 1 mm. thick, and was on the point of rupturing. The first Cæsarean section was an infected one, and the recovery was septic. Sellheim (*see* under Traugott), out of five cases with later pregnancy, saw the same thinning in one of them. Bumm (*see* under Traugott, and Jolly) had done second operations in three cases; in two the scar was sound, in the third the scar was so stretched and thin that he thought at first it was distended bladder; in reality it was the scar bulged by the liquor amnii.

Reports of cases of cervical Cæsarean section with subsequent pregnancy, terminating either by repeated operation or natural delivery, are given by Hartmann, Lichtenstein, Litschkuss, Rohrbach and Scheffzek, amongst others. Hartmann reports twelve cases, three of which were delivered by the natural passages, and nine by repeated operation; in none was there rupture or thinning of the scar. Lichtenstein reports two cases of subsequent delivery after the extraperitoneal operation, one by repeated operation, and the other by the natural delivery of twins; no complications were noted. Rohrbach followed up thirty-eight cases of cervical Cæsarean section, and found three subsequent deliveries: one normal full time labour and two repeated operations. Scheffzek reports ten cases of pregnancy subsequent to extraperitoneal Cæsarean section: five with repeated operation, and five with delivery by the natural passages.

The above are only a few of the published lists of pregnancies subsequent to cervical Cæsarean section, but the numbers are still so small, so that it is hardly justifiable to draw conclusions. I believe I am right in stating that up to the present time no further case of rupture of the cervical scar has been reported. The operation is certainly gaining favour, especially in America; British and French obstetric surgeons are still shy of it. The low mortality reported by exponents of cervical Cæsarean section is remarkable compared to that of the classical operation: For the transperitoneal operation up to 1914, Hofmeier reports forty-five cases, with one death; Baisch reports nineteen cases, without a death; Frank reports 130 cases with two deaths; giving a total of 194 operations with three deaths. Half of these were suspect and infected cases. For the extraperitoneal operation, Küstner had 110 cases without a death, of which again half were suspect or infected. The grand total comes to 304 cervical operations, with three deaths—a very remarkable figure, especially as a large number of the patients was infected.

Although the consideration of scars resulting from vaginal hysterotomy (so-called vaginal Cæsarean section) does not belong to the subject of rupture of the Cæsarean section scar proper, it is interesting to consider the possibility of their rupture in a subsequent pregnancy or labour, since in both vaginal hysterotomy and cervical Cæsarean section the incisions lie in much the same part of the uterus. The behaviour of these scars in subsequent labour has been investigated by Olow; he reports seventeen cases, mostly performed for eclampsia; in none of them was thinning or rupture of the scar observed. Engström reports a case of rupture of the lower uterine segment six years after vaginal hysterotomy for vesicular mole. The case was one of obstructed labour from pelvic contraction, and the retraction ring reached almost to the umbilicus. The site of rupture corresponded to the line of the scar; but the case is hardly a fair one, as rupture would have probably occurred in any case, former operation or no. An example of rupture of the scar of a deep cervical incision (made for placenta prævia) in a subsequent labour is reported by Labhardt. I have not found any reference to vaginal hysterotomy scars beyond these few.

The Influence of Implantation of the Placenta over the Scar.

The relation of the placenta to the scar at the time of rupture was noted in fifty-one of the ninety-seven cases; in thirty-four cases it was implanted over the scar. and in seventeen it was not. From this it may be assumed that the implantation of the placenta has at all events a share in predisposing the scar to rupture, but far too great importance has in the past been attached to this point. That the placenta cannot be the direct cause of rupture is obvious enough, for, on the one hand, the placenta is very often not over the scar in cases of rupture, and on the other, in cases of repeated Cæsarean section it is often found over the scar without any harmful effect. The idea that implantation of the placenta over the scar was the cause of rupture came very early into the field. It was known that rupture of the pregnant tube was caused by the eroding action of the villi, and that in certain cases of placenta prævia the lower uterine segment was appreciably weakened and more liable to traumatic rupture. An analogy between these two and scar rupture was tempting; but there is no histological evidence to show that chorionic villi invade the scar tissue any more than they do normal uterine tissue. It has also been suggested that when at the original Cæsarean section the incision is over the placental site perfect healing is interfered with; there is no histological evidence for this. Amongst the ninety-seven cases of ruptured scar the relation of the incision to the placental site of the original Cæsarean section is only mentioned in sixteen cases, in ten of which the incision was over the placental site. Nothing can be inferred from these figures; it must be remembered that when the operator encounters the placenta in his incision he may state the fact in his records, but that he is much less likely to state the negative fact. A large number of uteri which bear Cæsarean section incisions, removed subsequently by hysterectomy, and where the full details of the Cæsarean section are known, has now been reported (refer to Whitridge Williams and Spalding amongst others). No fact has been forthcoming to show that the placenta has any influence on the healing of Cæsarean section incisions, or on the rupture of Cæsarean section scars by tissue invasion.

I believe the real reason why implantation of the placenta over a thin scar makes it liable to rupture is the occurrence of retroplacental hæmorrhage. The first step towards this is a gradual yielding and widening of the scar area; there follows a very gradual, and probably very slight, separation of the placenta over and adjacent to the scar area. The mechanism of this separation is comparable to the separation of a placenta prævia from the lower uterine segment when the cervix begins to dilate. Hæmorrhage between the scar area and the placenta will bring about a sudden rise of pressure sufficient to precipitate rupture. In my own Case II there was beneath the peritoneal scar area a well defined subperitoneal hæmatoma, which had extended laterally, stripping the peritoneum off the uterine wall; I do not think this occurred entirely after the event. Attention is directed to case abstract No. 85, in which there was a well defined blood clot on the maternal surface of the placenta, and there can hardly be any doubt that hæmorrhage between the scar area and the placenta was the direct cause of the rupture.

On the Effect of Sepsis on the Healing of the Uterine Wound.

Of all the causes of imperfectly healed scars, sepsis is by far the most important. Reference to the table shows that the presence or absence of raised temperature or of sepsis during recovery from the Cæsarean section is mentioned in sixty-six cases; in as many as fifty-one cases either raised temperature, or definite uterine or abdominal sepsis is noted. In only fifteen of the sixty-six is an afebrile recovery noted. It is, of course, obvious that infection and suppuration of the uterine incision must, of necessity, be followed by imperfect healing. If the septic process be severe, the uterine tissues included between the sutures will undergo necrosis; the sutures will cut out, the muscular walls will retract, and the end result will be a scar which consists of little more than peritoneum with a protective layer of omental or other adhesions. Even if the sutures do not cut out, the wound will have to pass through a stage of granulation tissue, and will result in a broad, fibrous scar. If silk be employed, the suppurative process will continue until the silk sutures have come away; cases have been recorded in which silk sutures were found in the uterine discharges. Of the two cases recorded by Wyss, in one silk stitch sinuses persisted for many months, and in the other, after a persistence of stitch sinuses, the linen thread sutures were removed from the interior of the uterus by curetting. If catgut be employed, its absorption will be hastened by sepsis. The point will be raised that in fifteen cases of rupture there was no evidence of sepsis in that the convalescence was afebrile. But infection of the uterine wound may occur without rise of temperature, or with only a very slight one; for example, few will deny that the presence of extensive adhesions to the scar at a subsequent operation is evidence of sepsis during the healing process, and there must be a good many operators who have found these adhesions when the temperature chart of the original Cæsarean section did not betray any indication of sepsis. For example, in 1913 I performed a second operation on a patient on whom the first Cæsarean section had been performed in 1902 by the late Mr. John Taylor, of Birmingham; I found extensive adhesions of the omentum to the abdominal wall and to the uterine incision, accompanied by such a number of enormously distended blood-vessels, that I had to eventrate the uterus and incise its posterior wall. After the uterus had been emptied, palpation of the old scar showed that it was extremely thin in places, and formed a series of deep pits on the inner surface of the uterus. I was fortunate enough to obtain complete notes and temperature charts of the first operation. The temperature had been charted every two hours during the first five days; on the second day the highest record was 99·6° F., on the third 99° F., on the fourth 98° F., on the fifth 98·4° F. During the following days the only records above normal were 99·2° F. on the ninth day, 99·8° F. on the eleventh, and 99·6° F. on the fourteenth. The abdominal wound healed by primary union, and the patient made an exceptionally smooth convalescence. Silk was employed to suture the uterus. Here there had clearly been infection of the uterine wound, and yet the temperature chart did not betray it. If the abstracts of cases with the afebrile recovery be referred to it will be noted that the ruptured scar was of the same thin peritoneo-decidual nature, in no way differing from other cases. The point is, that although the temperature chart may be a smooth one, infection of the uterine wound may occur, sufficient to impair healing.

In connexion with infection of the uterine wound, I believe that the operation of Cæsarean section can never be guaranteed as a surgically clean one; for there is a large wound in a mucous cavity in direct communication with, and within a short distance of, a contaminated area (the vulvo-vaginal tract). I admit that pathogenic bacteria capable of infecting the tissues are seldom present in a normal vagina, unless vaginal examinations have been made. This is a point I will not enter into any further, as it would have to be very closely argued; but it is sufficiently well known that hæmolytic streptococci have frequently been found in the normal puerperium, not only in the vagina, but also in the apparently healthy uterus. I have been surprised by the large number of Cæsarean section cases in which the recovery was febrile; in the London Hospital and City of London Maternity Hospital series of eighty-four cases, recovery was afebrile in only thirty-eight, or 45 per cent. (trivial rise of temperature in first forty-eight hours of course not counted). I only make this as a general statement, and think it is a point which might advantageously be inquired into.

A study of the type of convalescence from the Cæsarean section is of the utmost importance in arriving at a decision as to the management of future pregnancies. If the convalescence has been febrile and there has been other evidence of sepsis, the scar is probably thin and there is risk of rupture. If, on the other hand, convalescence has been afebrile, the chance of rupture is a very small one, but it is quite plain that there is no absolute guarantee against rupture, since an appreciable number of cases of rupture have been reported even after an afebrile convalescence. On the other hand, it can be shown that patients whose convalescence has been accompanied by even considerable fever can successfully deliver themselves on a future occasion by the natural passages.

To sum up, it cannot be too strongly emphasized that infection of the uterine wound is, above all others, the essential cause of weak scars.

On Suture Material and Method of Suture.

In all the cases under review (except in case abstract No. 13) the entire thickness of the uterine wall was sutured either by introducing buried layers, or by using deep sutures which passed through the whole thickness of the uterine wall except the endometrium. There is no need to dwell upon this point, as it may be taken for granted that all modern operators take good care to unite the whole thickness of the uterine wall.

Great controversy has raged over the question of the best suture material for closing the uterine incision. On looking at the table it will be noted that, out of the fifty-three cases in which the suture material used for the deep sutures is mentioned, catgut was employed in forty-one, and silk in twelve; in most of the cases in which silk was used there was also a superficial peritoneal suture, burying the knots of the deep layer. It would be false reasoning to conclude from these figures that rupture is more liable to occur after catgut than after silk. Before it is justifiable to come to such a conclusion it would be necessary to know the relative frequency with which silk and catgut were employed. In Great Britain, up to the year 1910, Dr. Amand Routh's book tells us (p. 23) that, of the eighty-one operators who sent him particulars, forty-one used silk for the deep sutures, twenty-seven catgut, eight silkworm gut, and four linen thread. Since the date of this inquiry, amongst those surgeons who have sent me particulars of their cases for the period under investigation (1912-18) the use of catgut is far more customary than that of silk (*see* p. 54). From reading modern text-books and monographs by American and German authors it is apparent that catgut is almost universally used in those countries; in France, silk is still preferred. There seems to be no doubt that catgut has been in the past, and still is, far more commonly employed than silk. It is not justifiable therefore to conclude from the figures relating to the use of catgut and silk respectively, in cases of ruptured scar, that catgut is more blameworthy than silk.

The suture material can, of course, only be of importance during the process of healing, and so long as a slowly absorbable preparation of catgut, such as chromic, is used, capable of resisting absorption for at least three weeks, there can be no objection to its use so long as the wound is healing aseptically. A point that has been emphasized is that in the involuting uterus the intracellular enzyme activity is considerably raised, and that therefore a protein material, such as catgut would be absorbed more quickly than in other tissues; this point is a sound one, and is sufficient reason for not employing plain catgut, which is quickly absorbable. If the uterine incision becomes infected, the process of healing is of course considerably delayed, and the absorption of catgut hastened; for this reason I think catgut has serious disadvantages. In the case of an infected wound, the muscular edges of which are constantly tending to be drawn apart by the retractile power of the muscle it is important that the edges should be kept in apposition for as long as possible. Here catgut fails, and a less absorbable material is far preferable. Since it is, in my opinion, impossible to guarantee aseptic healing of the uterine incision, I believe that catgut should be avoided.

Considering now the two types of non-absorbable suture, we have to consider silk or linen thread, and silkworm gut. Theoretically, silkworm gut is by far the preferable of the two; it is well known that if infection occurs silk encourages the process of suppuration, which goes on almost indefinitely, and seldom ceases before the sutures have come away naturally or have been removed. Silk, in an infected wound, is an irritant, and an inveterate harbourer of bacteria. On the other hand, silkworm gut is an absolutely inert material in the presence of bacteria, and the presence of silkworm gut sutures has little or no influence in prolonging the suppurating process. My own opinion is strongly in favour of the use of silkworm gut for the deep uterine sutures, firstly because it is a non-absorbable material and will hold the sides of the uterine incision in place for an indefinite period of time, unless, of course, they cut out owing to an extensive necrosis of the tissues; secondly, because it is an inert material in the presence of bacteria. It is interesting to note that there has been reported no case of ruptured scar in which silkworm gut has been employed. It would be wrong, of course, from this to jump to a too obvious conclusion; the fact may well be explained because silkworm gut is relatively very seldom employed in Cæsarean sections.

Another point I consider of great importance in suturing is to wait for complete retraction before inserting the sutures: if the wound is sutured before retraction is complete, and the muscular walls are thin, the result is bound to be a scar thinner than the rest of the uterine wall; for the sutures fail to include layers of muscle fibres which during complete retraction would have slid inwards and become rearranged, adding to the thickness of the sides of the incision.

Accidental Factors in Causation of Rupture.

Any circumstance in pregnancy or labour which is likely to strain the scar to an exceptional degree may precipitate rupture in a case in which, under ordinary circumstances, the scar, though a weak one, might have remained intact. Such circumstances in pregnancy are the over-distension of the uterus by hydramnios, excessive size of the fœtus, or twins, a large retroplacental hæmorrhage, or the introduction of a hydrostatic bag; in labour, prolonged or obstructed labour, internal version or the use of pituitrin. In case abstract No. 14 the patient fell out of bed and got symptoms suggestive of rupture. It will be noted that such accidental factors are recorded in only seventeen of the ninety-seven cases. A study of these cases points the moral that patients who bear Cæsarean section scars should not be allowed long labours and that the employment of version, bags, or pituitrin and such like drugs, is to be avoided.

Some Clinical Points.

Parity, interval between the Cæsarean section and rupture, number of Cæsarean sections preceding rupture, treatment, and result to mother and child, require no further comment here. The bare facts are sufficient, and will be found in the summary of cases. Other points deserve closer consideration.

Labours intervening between Cæsarean Section and Rupture.—In eight cases one delivery by the natural passages occurred between the two events. Why did the uterus stand the stress of one pregnancy and labour, only to yield to it in the next? We naturally turn to inquire whether any additional stress had been put on the scar beyond that of the normal state; whether anything occurred likely to have raised the intra-uterine pressure or to have increased the difficulties of labour? In four cases (*see* abstracts) we find unusual circumstances; in No. 19, the labour lasted twenty hours and the pelvis was contracted; in No. 30 the placenta was implanted over the scar; in No. 43 delivery was by internal version, and in No. 59 labour was induced by a hydrostatic bag for toxæmia of pregnancy. In the other four there was no abnormality of pregnancy or labour; it is unwise, therefore, to indulge in any false sense of security merely because a patient has already delivered herself by the natural passages.

Period of Pregnancy at which Rupture occurred.—In seventy out of the eighty-seven cases in which the period is stated, the scar ruptured at full term or within a month of it. In Case 15 (full details in the abstract) either the scar had ruptured at a very early period of pregnancy, or, what is much more likely, the original Cæsarean section incision had always remained open from imperfect healing, and was sealed by adhesions only; the ovum had developed partly in the uterus and partly in the abdominal cavity. The fœtus lay in an intraperitoneal gestation sac—a case of secondary abdominal pregnancy, In Case 34, a partial rupture occurred in the fourth month, which was completed at the seventh. Of the cases where rupture occurred in the seventh month (*see* summary), in only two was there any explanation for such early rupture; in No. 65, a bag was inserted for placenta prævia, and in No. 70 the placenta was implanted over the scar. Circumstances which should favour early rupture are implantation of the placenta over the scar and retroplacental hæmorrhage, hydramnios, and operative manipulation; also excessive thinness of the scar, especially where there are gaps in the line of the scar merely closed by omental adhesions.

In No. 48 the fœtus was post-mature and very large, and rupture was postponed until the eleventh month.

Moment of Rupture: during Pregnancy or during Labour.—It will be observed from the summary that in the eighty-four cases in which this point is stated, rupture occurred during labour in forty-eight and before the onset of labour in thirty-six. Of the former, rupture occurred early in the first stage in twenty-nine. This aspect of the subject is plain enough; a scar is much more strained during uterine contractions than during the quiescent period of pregnancy, and if labour be allowed to continue for a long time, especially if obstructed, the scar is subjected to an unwarrantable strain. A point worth bearing in mind is that for many patients who go into labour subsequently to a Cæsarean section, the labour is for all intents and purposes a primiparous one. At all events, a patient who has had labours previous to the operation is less likely to strain her scar and get a rupture than a patient whose operation was done when she was a primigravida. Other circumstances which obviously favour rupture during pregnancy and before the onset of labour pains are overdistension of the uterus and implantation of the placenta over the scar with retroplacental hæmorrhage; only a few examples of such will be found amongst the thirty-six reported cases, and it must be assumed that thin scars often yield under the influence of the normal intra-uterine pressure. A sinister feature of rupture of Cæsarean section scars is that the accident may occur during pregnancy, and from the seventh month onwards. This makes it difficult for us, however forewarned by our knowledge of the risk run by the patient, to protect her completely from the consequences; we cannot very well keep her under close observation in a hospital or nursing-home from the seventh month onwards, ready to operate at the first sign or symptom.

Cases with Absence of, or with very Slight, Symptoms.—All are familiar with the usual signs of rupture of the uterus: sudden pain, collapse, signs of intraperitoneal bleeding, cessation of labour pains and the distinctive feeling of the fœtus and retracted uterus. The point about these cases of ruptured scar is that the signs and symptoms are often extremely slight and are not seldom absent altogether. The explanation is not far to seek; instead of the whole thickness of the uterine wall being torn through, only a membranous and avascular scar has yielded; instead of sudden rupture being determined by powerful and prolonged uterine action in an exhausted patient, the rupture often occurs quietly and gradually during pregnancy or the early stage of labour. The membranous scar yields at one point, a small bag of membrane bulges through, and the patient goes into labour, as it were, through a gradually yielding scar until the ovum is born into the peritoneal cavity. The severity of the symptoms is naturally dependent on the position of the placenta. If the placenta is implanted over the scar hæmorrhage is likely to be very severe; if the placenta is well away from the scar, it separates and is expelled into the peritoneal cavity with very little more hæmorrhage than occurs after a normal third stage of labour. In cases in which the rupture is partial and the ovum is still in the uterus, acute symptoms are obviously not to be expected. In some cases a partial rupture, sometimes only a small perforation, has been quite unexpectedly discovered at a repeated Cæsarean section (*see* case abstracts Nos. 28, 33 and 56). If the placenta is over the scar, even a small perforation may be accompanied by considerable intraperitoneal hæmorrhage, as in case abstract No. 93. Apart from the type of rupture (i.e., whether complete or a mere perforation) the abstracts contain six cases where symptoms were absent (case abstracts Nos. 15, 24, 27, 40, 66 and 81) and fourteen in which they were slight (case abstracts Nos. 12, 14, 21, 22, 33, 35, 52, 56, 64, 79, 80, 83, 86 and 91). Three cases of complete rupture, accompanied by escape of the fœtus and placenta into the peritoneal cavity, with extremely slight and misleading symptoms may be quoted as examples. In Case No. 12 the absence of symptoms caused a mistake in diagnosis; there was no collapse, only a slight alteration in pulse tension and rate, and slight abdominal pain and tenderness. In Case No. 64 the only symptoms were a slight indefinite bearing-down pain and a feeling of weight in the lower abdomen, worse on standing. In Case No. 91 there was no intraperitoneal hæmorrhage or shock; there was diffuse abdominal pain for a few days, after which the patient was comparatively comfortable, walking about with little inconvenience.

On the Frequency of Rupture.

Upon this all-important point we possess, up to the present, no reliable information. A statement is often found that rupture of the scar follows Cæsarean section in 2 per cent. of cases. It has been of great interest to follow this tradition to its source; it was introduced by Couvelaire, quoting van Leuwen. I cannot get at van Leuwen's thesis (a Dutch one), and the summary he has published[1] is very confusing. To begin with, his method of estimating the percentage of ruptures was fallacious; he collected from literature all reports of cases of pregnancy following Cæsarean section, including chiefly cases of repeated operation and ruptured scar. By comparing cases of rupture with cases of pregnancy that did not rupture, he calculated the percentage frequency of rupture. Quite apart from the faulty method, the conclusions that have been drawn from his figures are inaccurate and confusing, as will be obvious to anyone who cares to read his published summary.

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[1] *Annales de Gyn. et d'Obst.*, October, 1904.

Harrar, reviewing the records of fifty repeated operations at the New York Lying-in Hospital, found two partial and two complete ruptures of the scar. Spalding states that, of forty patients who had Cæsarean section in his clinic or in his private practice, only one patient, to his knowledge, had had spontaneous labour later. This patient, after one spontaneous labour, got rupture of the scar in her next pregnancy (case abstract No. 64). Olshausen, in discussing Prüssmann's case (No. 16), said it was the only rupture out of at least 120 cases at his clinic. Jolly refers to his case (No. 50) as the third during the last thirty years at Olshausen's clinic. Asa B. Davis states that he had had only nine ruptured scars out of the 360 Cæsarean sections he had done (? personally). These figures, interesting as they may be, throw no light whatever on the frequency of ruptured Cæsarean section scars.

There is only one way of estimating this, by getting the subsequent obstetric history of a large number of Cæsarean section patients, and this forms the subject of Part III.

(III) THE RESULTS OF A FOLLOW-UP INQUIRY INTO THE SUBSEQUENT HISTORY OF A SERIES OF CÆSAREAN SECTION PATIENTS OPERATED ON BETWEEN 1912 AND 1918.

I wish first to draw attention to an elementary point which is often overlooked in referring to the frequency of rupture of the scar. The number of cases of ruptured scar compared to the total number of cases of Cæsarean section does not give the required information, for many Cæsarean section patients never have a subsequent pregnancy. It is necessary to know the number of cases of ruptured scar compared to the number of cases of subsequent pregnancy that advanced to, or near to, full term (i.e., delivered by natural passages or by repeated Cæsarean section; abortions not reckoned). There is only one way of finding out the frequency of ruptured scar; it is to get the subsequent obstetric history of a large number of Cæsarean section patients, over a definite period of years. I was, of course, especially concerned about the five cases of rupture at the London Hospital, and was anxious to find out what proportion these cases bore to the number of our Cæsarean section patients who subsequently became pregnant. This meant a follow-up inquiry. The difficulty was to decide how far back to go in selecting a year for the beginning of the period of inquiry. It was useless to go too far back, as there would be a small chance of getting hold of patients who had their operation at too remote a date, in a class that changes its abode so often. I decided on the period 1912 to 1918. The results of this inquiry would give the frequency of ruptures at the London Hospital, but it would not give a reliable figure for the percentage of ruptures in general, for the London Hospital cases were only a small sample selected from the mass of cases throughout the country. Further, it was a special sample, in that it contained, without a shadow of doubt, a high proportion of cases of ruptured scar. A much larger and more mixed sample was necessary. So, to begin with, I decided to add to the London Hospital cases the cases from the City of London Maternity Hospital, taken over the same period; in the latter hospital there had been no case of ruptured scar. (The operations were performed by myself and my past and present colleagues at these two hospitals, viz.: Drs. Russell Andrews, Comyns Berkeley, H. Williamson, the late Drummond Maxwell, Abernethy Willett, John Barris, Gordon Luker and Gordon Ley.) These combined figures work out as follows:—

Total number of Cæsarean sections (excluding fatal cases, sterilized cases, and cases of repeated Cæsarean section where the first operation was performed prior to 1912)	112
Number of patients who were followed up	84
Number in whom no subsequent pregnancy occurred	49
Number who subsequently became pregnant	35
Results of pregnancies:—	
Delivery by natural passages	10
Repeated Cæsarean section	15
Abortion	5
Pregnant now	4
Rupture of the scar	5

These figures are depressing in the extreme; they show that five pregnancies out of thirty (i.e., after deducting abortions and patients in the early months of pregnancy), or 16 per cent. resulted in rupture of the scar, and that there were half as many ruptures as deliveries by the natural passages. They further showed an unexpected degree of sterility following the operation.

Leaving now the main line of argument for a moment, I will refer to an objection which can be raised against these figures ; it is that the follow-up failed in 25 per cent. of the patients, and that some of these patients may have become pregnant, and may have got ruptured scars, or have had spontaneous deliveries, or what not. My own conviction is that these patients either did not become pregnant or had early abortions. If they had been expecting confinements they would almost certainly have sought the advice of their hospital, except in the few cases where they had left London. If all the patients had been successfully followed up the only result would have been the recording of a still higher percentage of sterility.

To return to the main argument, it was essential to take a much larger sample of cases than that taken from the London and City of London Maternity Hospitals if the figures were to be statistically reliable. As it seemed of such immense importance to get at the truth, I decided to try and get the results of Cæsarean sections done throughout the country during the same period. I, therefore, wrote to many obstetric surgeons in active hospital practice, asking them to collaborate with me in a collective investigation. This investigation has been a complete success, in that we are in possession of the subsequent obstetric history of 1,103 cases of Cæsarean section (including the London Hospital and City of London Maternity Hospital cases already referred to) performed between the years 1912 and 1918, inclusive.

Result of the Collective Investigation.

In Table I are displayed the number of cases and their sources, together with the number followed up, the number that subsequently became pregnant, and the mode of termination of the pregnancies. The suture material, as used in the total number of Cæsarean sections, is also shown. The table may be summarized as follows :—

Total number of Cæsarean section patients (excluding fatal and sterilized cases, and cases of repeated Cæsarean section where the first operation was performed prior to 1912)	1,605
Number followed up	1,103
Number in whom no subsequent pregnancy occurred	616
Number who subsequently became pregnant	487
Results of pregnancies :—	
Delivery by natural passages	78
Repeated Cæsarean section	352
Abortion	47
Pregnant now	86
Rupture of scar	18

(The discrepancy between the number of pregnancies and the number of patients who became pregnant is, of course, accounted for by the fact that some patients became pregnant more than once.)

A good many interesting points could be worked out from the lists of cases I have had sent me; for example, the sterility rate that follows Cæsarean section. But here I intend only to work out two, viz., the frequency of rupture and the suture material. (The publication in full of the lists of cases will give anyone who so wishes the opportunity of working out other points, or for checking my own results.)

The Frequency of Rupture.

Out of the 487 patients who became pregnant, eighteen (or 3·6 per cent.) got ruptured scars. This figure does not represent the true frequency of rupture; it is necessary to know the frequency of rupture amongst the pregnancies that went to, or near to, term and were therefore liable to ruptured scars.

TABLE I.

	Total patients	Followed up	No subsequent pregnancy	Subsequent pregnancy	Delivered natural passages	Repeated Cæsarean section	Abortions	Pregnant now	Rupture	Sutured with		
										Catgut	Silk	Silk-worm gut
St. Mary's, Manchester ...	243	190	96	94	4	79	13	21	1	188	1	—
Queen Charlotte's Hospital ...	175	88	49	39	8	24	5	7	—	3	70	8
Glasgow Royal Maternity and Women's Hospital	143	82	40	42	5	31	5	4	1	36	31	—
Liverpool Maternity Hospital	142	83	30	53	8	38	2	12	3	82	—	—
Jessop Hospital	128	105	64	41	8	37	3	2	4	84	30	—
Leeds Maternity Hospital ..	93	63	35	28	2	30	2	—	1	63	—	—
London Hospital	65	52	29	23	5	12	2	2	5	25	22	5
St. Bartholomew's Hospital	59	22	10	12	5	11	—	1	—	—	—	25
Guy's Hospital	57	45	18	27	7	13	3	6	—	45	—	—
Middlesex Hospital	56	36	22	14	4	10	3	2	1	21	14	—
Mr. F. Jordan	50	43	29	14	—	7	—	8	—	43	—	—
City of London Maternity Hospital	47	32	20	12	5	3	3	2	—	1	27	4
Edinburgh Maternity Hospital	46	38	27	11	1	8	—	3	—	12	27	—
General Lying-in Hospital, York Road	46	28	20	8	—	7	—	2	—	3	15	7
St. Thomas's Hospital ...	44	27	15	12	4	7	1	2	1	17	10	—
Leeds General Infirmary ..	41	38	22	16	5	12	1	3	—	38	—	—
Rotunda Hospital	40	28	14	14	4	6	—	5	1	2	27	—
Mr. F. Edge	36	25	15	10	1	7	1	1	—	25	—	—
Dr. B. Whitehouse	30	20	13	7	—	3	3	2	—	20	—	—
St. George's Hospital ...	16	14	13	1	—	1	—	—	—	—	—	14
Mr. C. Martin	15	15	13	2	—	2	—	—	—	12	3	—
Westminster Hospital ..	11	11	9	2	—	1	—	1	—	—	11	—
Dr. B. Solomons	8	5	4	1	—	1	—	—	—	5	—	—
Mr. Darwall Smith (private)	7	7	7	—	—	—	—	—	—	—	—	7
Women's Hospital, Birmingham	7	6	2	4	2	2	—	—	—	6	—	—
Total ...	1,605	1,103	616	487	78	352	47	86	18	731	288	70

Adding together the repeated Cæsarean sections, the deliveries by the natural passages and the ruptured scars, we find they come to 448. The true frequency of rupture is eighteen in 448, or 4 per cent. It is also interesting to note that the proportion of ruptured scars to successful deliveries by the natural passages is 18 to 74, or 1 to 4·3.

The Suture Material.

Out of 1,089 Cæsarean sections in which the suture material is noted (*see* Table I), in 731 catgut was used, in 288 silk, and in seventy silkworm gut. In a few cases, combined deep sutures of catgut and silk or silkworm gut were used; these have not been reckoned. The frequency with which these suture materials were used in general works out at 67 per cent. catgut, 26 per cent. silk, and 6 per cent. silkworm gut (incidence of catgut to silk equals 1 in 2½).

In the cases of ruptured scar, catgut was used in fifteen cases, silk in two, and in one case there is no record of the suture material. In no case was silkworm gut used. The frequency with which the suture materials was used in cases of ruptured scar, works out at 88 per cent. catgut, 12 per cent. silk, 0 per cent. silkworm gut (incidence of catgut to silk equals 1 in 7). The number of silkworm gut cases is, of course, too small to draw conclusions from. It is thus apparent that the incidence of catgut to silk in cases of ruptured scar is nearly three times its incidence in Cæsarean section in general. From this it might be inferred that scars are nearly three times as liable to rupture after the use of catgut as after the use of silk.

But to this conclusion a reasonable objection may be raised; it may be urged that perhaps very few cases of pregnancy followed the use of silk compared to the number that followed catgut. For example, if only ten or twenty cases of advanced pregnancy, or labour, occurred amongst the silk cases, silk would come badly out of the ordeal, with two ruptures to its credit. This objection can quite easily be met and overcome. It is necessary to find out the proportion of ruptures to advanced pregnancies amongst the silk cases, and compare it to the proportion of ruptures to advanced pregnancies amongst the catgut cases. This information is set out in the following table:—

	Repeated Cæsarean section	Delivery by Natural passages	Rupture	Total
Catgut ...	237	49	15	301
Silk ...	72	19	2	93
Silkworm gut ...	15	6	0	21

This shows that fifteen ruptures occurred in 301 cases of advanced pregnancy (i.e., repeated Cæsarean section, plus delivery by the natural passages plus rupture) after the use of catgut, a proportion of 1 in 20; and that two ruptures occurred in ninety-one cases after the use of silk, a proportion of 1 in 46·5. That is, about 2 per cent. of the silk cases, and 5 per cent. of the catgut cases were followed by rupture in subsequent pregnancy.

The liability to rupture after catgut is, therefore, nearly two and a half times the liability after silk.

Put in another way, if silk had been used instead of catgut in the above 301 catgut cases, and rupture had occurred in the same proportion as for the silk cases, there would have been only six ruptures instead of fifteen, and the total number of ruptures for all cases would have been reduced from seventeen to eight.

From the facts revealed by these figures, I have no hesitation in declaring catgut to be a dangerous suture material for Cæsarean section, and in asserting that henceforth it should be discarded.

In conclusion, I wish to tender my most sincere and heartfelt thanks to my fellow obstetric surgeons in the British Isles who have so generously responded to my call for a collective investigation. The collection of these lists has occasioned an immense amount of careful work to those who have undertaken the task. It is the utmost gratification to me, as I am sure it is to them, that our work has met with success, and has revealed so many outstanding facts about a subject which is of such great importance to us all.

CONCLUSIONS.

(1) The frequency of rupture of the Cæsarean section scar in subsequent pregnancy or labour (abortions excluded) is 4 per cent.

(2) The cause of ruptured scar is imperfect healing, leading to a thin scar in which muscular union has failed, and which consists of little more than peritoneum and decidua with a varying amount of intervening fibrous tissue.

(3) All thin scars stretch during pregnancy; rupture of a thin scar may be determined solely by the intra-uterine tension of normal pregnancy, or by the uterine contractions of normal labour; or it may be favoured by various accidental factors, of which the chief is insertion of the placenta over the scar, with partial separation of the placenta and retroplacental hæmorrhage.

(4) Other accidental factors are over-distension of the uterus, prolonged or obstructed labour, operative interference, such as internal version, the insertion of hydrostatic bags, and the administration of such drugs as pituitrin.

(5) In the reported cases rupture occurred almost as often during pregnancy as during labour (in proportion of three to four); and many cases have been reported as early as the seventh month of pregnancy.

(6) The chief cause of imperfect healing is infection of the uterine wound; other causes are imperfect methods of suture and the employment of unsuitable suture material.

(7) As regards the suture material, catgut should not be used, for the liability to rupture after catgut is two and a half times the liability after silk. For theoretical reasons silkworm gut is the most suitable material.

(8) As regards the incision, the scar of the transverse fundal incision is especially liable to rupture. Only one case has so far been reported of rupture of the scar of the cervical incision.

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ABSTRACTS OF REPORTED CASES OF RUPTURE OF THE CÆSAREAN SECTION SCAR.

(1) Koblank, 1891. Reported by Hofmeier in *Berlin klin. Wochenschr.*, 1905, xlii, p. 835. 6-para. Cæsarean section, in 1887, at fifth labour, for contracted pelvis; anterior median incision; sutured with deep interrupted silk, and buried and superficial catgut. Febrile convalescence. Rupture of scar occurred in sixth labour at term, in 1891. Fœtus and placenta, with intact membranes, lay free in peritoneal cavity: much intraperitoneal hæmorrhage. Fœtus dead. Laparotomy, edges of rent excised, and rent sutured. Recovery. Scar ruptured throughout its whole length.

(2) Guillaume. *Zentralbl. f. Geb. u. Gyn.*, 1895, p. 1286. Aged 26, 2-para. Contracted pelvis. (1) Cæsarean section, 1893, anterior median incision, sutured in layers, suture material not stated, febrile recovery. (2) Rupture of scar, 1896, in seventh month, not in labour; laparotomy, fœtus and placenta, with intact membranes, free in peritoneal cavity. Subtotal hysterectomy, recovery. Fœtus dead. Rupture of whole scar, decidua extending to peritoneum. Guillaume refers to two similar unreported cases.

(3) Woyer. *Monatsschr. Geb. u. Gyn.*, 1897. vi. Aged 26, 2-para. Contracted pelvis. (1) Cæsarean section, February 21, 1893, anterior median incision, placenta beneath incision, sutured with deep interrupted silk and interrupted silk for peritoneum, febrile recovery. (2) Rupture of the scar, March 15, 1896, early in labour at full term, hydramnios; laparotomy, twins removed from abdominal cavity. Subtotal hysterectomy, death. Fœtuses dead. Rupture of whole scar; failure of muscular union.

(4) GALABIN. *Trans. Obstet. Soc. Lond.*, 1900, xlii, p. 243, mentioned by Horrocks in discussion on Targett's case. After a Çæsarean section, sterilization was attempted by ligaturing the Fallopian tubes. In spite of this she became pregnant; the uterus ruptured along the line of the incision when near full term; fœtus and placenta in peritoneal cavity. Hysterectomy, recovery. Fœtus dead.

(5) TARGETT. *Trans. Obstet. Soc. Lond.*, 1900, xlii. The patient had had a Cæsarean section two-and-a-half years previously for impacted shoulder presentation. Readmitted to hospital in a state of severe collapse. Fœtus and placenta found free in the peritoneal cavity; large rupture in anterior wall of uterus along scar of previous operation. Hysterectomy; patient recovered. Fœtus dead.

(6) SCHNEIDER. *Deutsch. med. Woch. Vereinsbeilage*, 1900, xxvi, p. 179. No details. The case was recounted of a patient who got rupture of a Cæsarean section scar (anterior median incision) during pregnancy. Placenta inserted over scar, and it was suggested that perhaps some of the sutures had not been passed deep enough.

(7) EVERKE. *Monatsschr. f. Geb. u. Gyn.*, 1901, xiv. 3-para. Contracted pelvis. (1) Difficult labour, dead birth. (2) Cæsarean section, 1897; anterior median incision sutured with deep interrupted silk and continuous peritoneal silk. (3) Rupture of scar, 1901, at term. Subtotal hysterectomy, recovery. Fœtus dead. Placenta implanted over scar.

(8) BAUBY and GILLES. *Toulouse méd.*, No. 21, November 1903, p. 243. Aged 27, 3-para. Contracted pelvis. (1) 1899, craniotomy. (2) Cæsarean section, 1901; anterior median incision, sutured with silk; recovery with suppuration in abdominal wound. (3) Rupture of scar, August 2, 1903, near term: laparotomy, fœtus and placenta, as intact ovum, removed from peritoneal cavity. Subtotal hysterectomy, death. Fœtus dead. Rupture of the whole scar.

(9) FÜTH. *Zentralbl. f. Gyn.*, 1903, xxvii, p. 257. Aged 26, 2-para. (1) Cæsarean section, March, 1900, for obstructing dermoid cyst, in labour at term; anterior median incision, febrile recovery. (2) Rupture of scar, August, 1901, in first stage of labour at term, membranes intact, cervix two fingers: intact ovum in peritoneal cavity. Subtotal hysterectomy, recovery. Fœtus dead. Rupture of entire length of scar.

(10) MEYER. *Zentralbl. f Gyn.*, 1903, No. 47, abstract only. Aged 26, 2-para. Contracted pelvis. (1) Cæsarean section, 1898; transverse fundal incision, sutured with deep and superficial interrupted catgut; febrile recovery; inflammatory pelvic swelling. (2) Rupture of scar, 1902, at term, early in labour; laparotomy; fœtus and placenta extracted through rupture; suture of rupture, recovery. Child lived. Rupture of whole scar, placenta implanted over it.

(11) EKSTEIN, E. *Zentralbl. f. Gyn.*, 1904, No. 44, p. 1302. Aged 33. 4-para. Contracted pelvis. (1) 1899, cranioclasm. (2) 1899, cranioclasm.

(3) August 26, 1901: Cæsarean section at term, in labour; transverse fundal incision; suture with deep interrupted silk, sero-muscular interrupted catgut, and continuous catgut for peritoneum; recovery without pyrexia; abdominal wound healed by first intention. (4) June 7, 1904: Rupture of scar at term, not in labour; fœtus and placenta free in peritoneal cavity. Subtotal hysterectomy, death. Fœtus dead. Specimen: Scar ruptured in entire length, decidua reached peritoneum at edges of rupture; scar in placental site.

(12) MUNRO KERR. *Journ. Obst. and Gyn. of Brit. Emp.*, 1904, vi, p. 378. 4-para. Contracted pelvis. (1) and (2) difficult labours, the last a craniotomy, and dead births. (3) Cæsarean section, October 28, 1901, in labour at full term: transverse fundal incision: placenta beneath incision; sutured with catgut: afebrile convalescence, no signs of sepsis. (4) Rupture of scar, January 27, 1904, at thirty-seventh week of pregnancy, not in labour; onset of symptoms gradual and without collapse; fœtus and placenta, in intact membrane, free in abdominal cavity. Fœtus dead. Subtotal hysterectomy. Recovery. Entire scar ruptured.

(13) RIBEMONT-DESSAIGNES. *Ann de Gyn.*, 2nd series, 1904, l, p. 632, 2-para. (1) Cæsarean section, at term, in labour; contracted pelvis, after attempts to deliver with forceps: the uterine incision was imperfectly sutured, only the peritoneum being united with catgut; febrile recovery. (2) Rupture of scar, at term, early in labour; laparotomy, fœtus and placenta still in uterus; scar ruptured widely enough to allow delivery of the fœtus through it; Porro operation. Recovery. Child living.

(14) SCHÜTTE. *Monatsschr. f. Geb. u. Gyn.*, 1904, xx, p. 886. Aged 22, 3-para. (1) Cæsarean section for eclampsia, June 27, 1901, at term, not in labour; anterior median incision; a utero-abdominal fistula, with adhesion of uterus to abdominal wall, formed during the febrile convalescence. (2) Rupture of the scar, October, 1902. In eighth month patient fell out of bed; severe abdominal pain and vomiting followed, subsiding after three days; two weeks later, laparotomy, removal of a macerated fœtus from abdominal cavity, uterus well involuted, intestinal adhesions to ruptured scar, sepsis. Drainage only. Recovery.

(15) HERMANN, R. *Bull. de l'Academie de Méd. de Belge*, 1904, 4th series, xviii, p. 146. Aged 29, 2-para. Contracted pelvis. (1) Cæsarean section April 26, 1901, at term, in labour, membranes ruptured; anterior median incision, sutured with catgut. (2) Rupture of scar, May 24, 1904, in labour at term, membranes ruptured; rupture diagnosed because fœtus was felt immediately beneath skin; no symptoms; no pain, no collapse, no tenderness, pulse 80; laparotomy, much meconium-stained liquor amnii in peritoneal cavity but no trace of blood or clot; fœtus removed; edges of large rupture in anterior wall of uterus thick and covered with adherent fœtal membranes which were continued into the small uterine cavity and reflected as usual over the placenta, which was inserted on the posterior wall. The rupture was obviously of long standing: either the uterus had ruptured

very early in pregnancy, or the original Cæsarean section had remained open from imperfect healing, and had been closed by adhesions only. The ovum had developed partly in the uterus and partly in the abdominal cavity. The sac of fœtal membranes lay in a sort of intraperitoneal gestation cavity, formed by adhesions between the sac and the omentum, intestine, rectum, bladder and abdominal wall. After removal of fœtus, placenta and membranes, the abdominal incision was closed, and a drain left at lower angle into uterine cavity; recovery. Fœtus dead.

(16) PRUSSMANN. *Zeitschr. f. Geb. u. Gyn.*, 1905, lv. Aged 40, 3-para. Contracted pelvis. (1) December 26, 1894, Cæsarean section at term; anterior median incision, sutured with catgut: afebrile recovery. (2) September 7, 1902: Cæsarean section at term, early in first stage of labour, membranes ruptured; uterine scar linear and not puckered; anterior median incision near fundus, sutured with deep interrupted catgut in muscle and continuous seromuscular catgut; afebrile recovery. In 1904, when two months pregnant, operation for ventral hernia, at which adhesions between uterus and omentum and abdominal wall were found and freed: inspection of the uterine scar showed it to be linear. (3) January 2, 1905: Rupture of uterus, at thirty-eight weeks, not in labour; fœtus and placenta free in peritoneal cavity; fundal scar ruptured in entire length; scar excised and sutured with deep interrupted catgut and continuous seromuscular catgut; recovery. Fœtus dead. Specimen: Edges of rupture uniformly 3 cm. thick and consisted of muscle, but covered with a thick layer of decidua extending up to the peritoneum. (There seems no doubt that Prussmann misinterpreted his specimen. The decidua-covered edges of the rupture were in reality ununited uterine muscle: the true scar, through which the rupture occurred, consisted of decidua and peritoneum, as in several other cases.—E. H.)

(17) SCHINK. *Zentralbl. f. Gyn.*, 1905, No. 32. Aged 28, 3-para, Contracted pelvis. (1) February 16, 1899: Cæsarean section at term, transverse fundal incision, sutured with two layers, deep and superficial, catgut; afebrile recovery. (2) 1900, labour at term, delivery by craniotomy. (3) Rupture of scar, July 8, 1902, during labour at term; laparotomy, fœtus and placenta, in intact membranes free in abdominal cavity; suture of rupture after excision of edges, recovery. Fœtus dead. Rupture of whole scar, which consisted of peritoneum and decidua; complete failure of muscular union. Placenta not in scar.

(18) WERTH. *Berlin klin. Wochenschr.*, 1905, xlii, p. 834. Aged 35. 3-para. Contracted pelvis. (1) Delivery by version, fœtus dead. (2) Cæsarean section, January 17, 1893, in labour, at term; anterior median incision, sutured with one interrupted buried and one continuous superficial layer of catgut; slightly febrile convalescence, offensive lochia. (3) Rupture of scar, January 21, 1905, at seven and a half months, not in labour; fœtus and placenta, with intact membranes, free in peritoneal cavity: fœtus dead: subtotal hysterectomy; recovery. Scar ruptured in entire length; placenta inserted over scar.

(19) WYDER. *Corres.-Blatt f. schweiz. Aerzte*, 1905, xxxv, p. 427. Aged 29, 4-para. Contracted pelvis. (1) Premature natural labour, dead birth. (2) Transverse presentation, dead birth. (3) Cæsarean section, 1898, at term, after labour had lasted three days, with transverse presentation; transverse fundal incision, sutured with silk; febrile recovery and suppuration in abdominal wound. (3) Premature labour at seventh month. (4) Rupture of scar, October, 1904, at term, in labour twenty hours; laparotomy, rupture 3 cm. by 1 cm.; after separation of many adhesions rupture was enlarged and dead fœtus extracted from uterus; subtotal hysterectomy, recovery. Placenta not implanted over scar.

(20) COUVELAIRE. *Ann. de Gynécol et Obst.*, 1906, p. 73. Aged 27, 2-para. (1) July 7, 1903: Cæsarean section for contracted pelvis, at term, in labour; anterior median incision; two layers catgut, ten interrupted sutures for whole thickness of uterine wall and superficial seromuscular suture; afebrile recovery ("slight rise of temperature for forty-eight hours only"). (2) December 6, 1905. Severe hydramnios, rupture of uterus, at term, at onset of labour; fœtus and placenta free in peritoneal cavity; subtotal hysterectomy, recovery. Fœtus dead. Specimen: Rupture to side of scar through very thin fibro-muscular tissue; almost complete absence of muscle-union, so that the abrupt thinning of the uterine wall formed a deep narrow cleft of which the stretched scar was the roof; scar in placental site.

(21) MABBOTT. *Amer. Journ. Obst.*, 1906, liv, p. 852. Aged 23, 2-para. Contracted pelvis. (1) Cæsarean section, August 21, 1902, at term, transverse fundal incision, sutured with three layers chromic catgut. (2) Rupture of scar, November 4, 1904, at term, after twenty hours of labour in first stage, with membranes intact and os two fingers dilated; symptoms slight, walked into ward; Cæsarean section; fœtal membranes protruded through a 7 cm. long rent in scar; recovery. Child alive. Incision and rent sutured; placenta not inserted over scar.

(22) MARTIN, A. *Medizin. Klinik*, 1906, xiii, p. 324 Aged 26, 2-para. (1) Cæsarean section, 1903, for eclampsia: transverse fundal incision; afebrile recovery. In 1904, abortion at three months. (2) Rupture of scar, February 1, 1906, at about seventh month, not in labour; insidious onset, walked into hospital, and only symptoms were those of intestinal obstruction; laparotomy, intact ovum in peritoneal cavity; rupture sutured, recovery. Fœtus dead. Rupture of scar in entire length.

(23) PADDOCK. *Illinois Med. Journ.*, 1907, xii, p. 195. Aged 36, 6-para. Contracted pelvis. (1) to (4) all difficult labours resulting in three dead births and one child that lived a few hours. (5) Cæsarean section, in labour at term, anterior median incision, uterus sutured with three layers of catgut. (6) Rupture of scar at term; fœtus and placenta, with intact membranes, free in peritoneal cavity; subtotal hysterectomy, recovery.

(24) SCHNEIDER. *Münch. med. Wochenschr.*, 1907, liv, p. 2038. Aged 25. 5-para. Contracted pelvis. (1) 1901, craniotomy. (2) 1902, premature

labour, dead birth. (3) 1903, craniotomy. (4) September, 1904: Cæsarean section, anterior median incision. (5) Rupture of scar, November 26, 1906, early in labour, no symptoms. During second Cæsarean, small perforation found in upper third of scar, through which a portion of placenta was protruding: incision through old scar and perforation; living child extracted; uterine incision sutured. Recovery.

(25) BRODHEAD. *Amer. Journ. Obst.*, 1908, lvii, p. 650, Aged 35, 6-para. (1) to (4) all labours difficult, resulting in dead births. (5) Cæsarean section. December 31, 1904; anterior median incision, sutured in layers of chromicized catgut. (6) Rupture of scar, November 26, 1906, at thirty-six weeks; not in labour; fœtus and placenta free in abdominal cavity; laparotomy; patient died a few minutes after incision was made; rupture at site of old scar. Fœtus dead.

(26) FOURNIER. *Bull. de la Société d'obstétrique de Paris*, 1908, ii, p. 162. Aged 26, 3-para. Contracted pelvis. (1) Cæsarean section in 1903, fundal incision. (2) Cæsarean section, 1906, fundal incision. (3) Rupture of scar, February, 1908: Premature labour at eight months induced by bougies and, later, by de Ribes' bag; after a few labour pains got sudden pain and collapse. Separation of placenta and concealed hæmorrhage diagnosed. Delivery by instrumental and manual dilatation of cervix and version; hand introduced to remove placenta found large rupture in fundus; vaginal hysterectomy, recovery. Fœtus dead.

(27) HARTMANN, J. *Zeitschr. f. Geb. u. Gyn.*, 1908, lxii. Aged 32, 2-para. Contracted pelvis. (1) April 6, 1906: Cæsarean section at term, not in labour; transverse fundal incision, placenta in line of incision; uterus sutured with five layers of continuous catgut, the first being musculo-decidual and the last two seroserous: recovery afebrile; abdominal wound healed by first intention. (2) December 29, 1907: Rupture of uterus, at term, in labour for five hours, os nearly fully dilated; dead fœtus delivered by forceps; vaginal hysterectomy, recovered. Remarkable was the absence of clinical signs and symptoms of rupture—no pain, no collapse, no anæmia, pulse always full and 80; after hysterectomy, only one largish clot was found in peritoneal cavity. Specimen: Scar ruptured in entire length; scar, at site of rupture, consisted of a thin membrane formed by peritoneum with a few muscle fibres and a layer of blood-infiltated decidua beneath; almost complete failure of muscle union; scar in placental site.

(28) MEYER. *L'Obstétrique*, 1908, No. 1-6. Aged 33, 2-para. (1) Cæsarean section for obstructed labour due to tumour of sacrum; transverse fundal incision, sutured with two layers of deep and superficial catgut; febrile recovery; sacral tumour removed seven years later. (2) Rupture of scar, eight years after Cæsarean section, near term, not in labour: rupture partial, and size of a five-franc piece; Cæsarean section performed through scar, followed by subtotal hysterectomy: recovery. Child lived.

(29) Lobenstine. *Amer. Journ. Obst.*, 1909, lviii, p. 670. 3-para. (1) Cæsarean section, 1904, in labour thirty-six hours, at term; anterior median incision, febrile recovery. (2) Cæsarean section in 1906: median incision through fundus, uterus sutured in three continuous layers with catgut; recovery afebrile. (3) Rupture of uterus, December, 1907, at term, in labour; laparotomy, fœtus and placenta free in abdominal cavity; supravaginal hysterectomy; recovery. Fœtus dead. Uterus ruptured from internal os up to fundus, through one of the two previous scars.

(30) Nacke. *Zentralbl. f. Gyn.*, 1909, xxxiii, p. 212. Aged 29, 3-para. Contracted pelvis. (1) Cæsarean section, 1904, at term, late in labour; transverse fundal incision, sutured with two layers. (2) Natural delivery, living child. (3) Rupture of scar, July 18, 1908, at term, during labour; breech labour, living child delivered without great difficulty; labour pains ceased after child had been born to umbilicus; two hours after delivery, sudden collapse; hand introduced into uterus, placenta removed, and rupture discovered; laparotomy: large rupture in fundus, many adhesions to omentum and intestine; rupture sutured with catgut, recovery. Rupture of scar in entire length; placenta implanted over scar; edges of rupture thick and smooth.

(31) Dahlmann. *Monatsschr. f. Geb. u. Gyn.*, 1910, xxxii. Aged 33, 2-para. (1) February 8, 1903: Cæsarean section for obstructing fibromyoma of cervix, at term, in first stage of labour; transverse fundal incision; placenta not in incision; uterus sutured with three layers catgut, deep and superficial; recovery febrile; inflammatory mass in pelvis; abdominal incision healed by first intention. (2) October 31, 1904: Rupture of uterus, at term, in early first stage of labour: moribund, post-mortem only. Specimen: Scar in placental site; adhesions to omentum; scar wide and thin, composed of decidua and peritoneum only, with a little intervening fibrous tissue; complete failure of muscle union.

(32) Dahlmann. *Monatsschr. f. Geb. u. Gyn.*, 1910, xxxii. 2-para. (1) October 22, 1905: Cæsarean section for varices of vagina; transverse fundal incision; scar in placental site; ten deep interrupted sutures for whole uterine wall including decidua, continuous silk for peritoneum; suppuration of abdominal wound; operation after three months for closing utero-abdominal fistula. (2) December 11, 1907: Rupture of uterus, at term, not in labour; whole intact ovum free in peritoneal cavity; subtotal hysterectomy, recovery. Fœtus dead. Specimen: Rupture of whole scar, which was wide and thin, and formed by union of peritoneum to decidua, with a little intervening fibrous tissue; complete failure of muscle union; scar partly in placental site; adhesions to omentum.

(33) Dahlmann. *Monatsschr. f. Geb. u. Gyn.*, 1910, xxxii. Aged 18, 2-para. (1) February 15, 1905: Cæsarean section for contracted pelvis, in labour at term; transverse fundal incision: uterus sutured with three layers of catgut, deep and superficial; convalescence febrile. (2) August 21, 1908: Rupture of scar found at second Cæsarean, at term in early first stage of

labour; in middle of wide and thin scar was a rupture the size of a crown piece with membranes bulging through; scarcely any bleeding; scar nowhere in placental site; adhesions to omentum; scar excised and sutured. The partial rupture had given no signs or symptoms, and was unsuspected before operation. Recovery. Child alive.

(34) RICHTER. *Gyn. Rundschau*, 1910. 2-para. (1) Cæsarean section: Anterior median incision; no further details of the operation or of its indication. (2) Rupture of scar several years later. The period of rupture is of special interest. In the fourth month, there was threatened abortion; as result of the uterine contraction partial rupture of the scar occurred and a utero-abdominal fistula formed, through which a coil of intestine could be seen adherent to the scar. In the seventh month further rupture of the scar occurred, with injury to the adherent intestine. Laparotomy; subtotal hysterectomy. Death from peritonitis. Placenta inserted over scar.

(35) SCHEFFZEK. *Zeitsch. f. Geb. u. Gyn.*, 1910, lxvii, p. 752. Aged 26, 2-para. Contracted pelvis. (1) Cæsarean section, April 20, 1897, at term, early in labour; anterior median incision: febrile recovery; suppuration of abdominal wound and bronchitis. (2) Rupture of scar, January 1, 1900, at thirty-six weeks, in first stage of labour, hydramnios. Rupture found at second Cæsarean section; symptoms not acute; anæmia, tender uterus, vomiting on admission to hospital but operation not considered urgent, and postponed for twenty-four hours. Intact ovum and much blood in peritoneal cavity. Subtotal hysterectomy, death next day from secondary hæmorrhage. Fœtus dead. Rupture of scar in entire length; placenta not over scar; scar consisted of peritoneum only.

(36) WEBER. *Beiträge z. Geb. u. Gyn.*, 1910, xv, p. 53. Contracted pelvis. Cæsarean section, July, 1907: Transverse fundal incision, over placenta, sutured with three layers of catgut. Rupture of uterus, September, 1908, early in labour, found at second Cæsarean section, which it must have anticipated by a few moments, fœtus and placenta still in uterus; fœtus extracted. Total hysterectomy, recovery. Child alive. Rupture of whole length of scar; placenta not over scar.

(37) CAMERON, S. J. *Proc. Roy. Soc. Med.* (Sect. Obst. and Gyn.), 1911, iv. Two Cæsarean sections, anterior median incision, sutured with catgut. Rupture of the scar occurred in the eighth month of pregnancy, not in labour. Post-mortem only: Intact ovum almost free in peritoneal cavity; scar ruptured in entire length; placenta attached over scar.

(38) CAMERON, S. J. *Proc. Roy. Soc. Med.* (Sect., Obst. and Gyn.), 1911, iv. Patient with contracted pelvis had a Cæsarean section; anterior median incision, sutured with catgut. In subsequent pregnancy, second Cæsarean section was done at onset of labour, three weeks before term. Margins of old scar, below peritoneal surface, widely separated by protrusion of membranes for a length of 2 in.; at lower end of this peritoneal bulge was a small rupture, through which blood was trickling. Extraction of live child by fundal

incision, subtotal hysterectomy, recovery. Specimen showed that over a large part of the scar peritoneum alone separated the uterine from the abdominal cavity.

(39) Cocq and Maray. *Revue Mens. de Gyn., d'Obst. et de Pediatrie*, 1911, No. 5; Abstract in *Zentralbl. f. Gyn.*, 1911, xlviii, p. 1655. 3-para. Contracted pelvis. Two Cæsarean sections. (1) Transverse fundal incision. (2) Anterior median incision, four years later. (3) Rupture of scar, five years after second operation. Death during laparotomy. Large T-shaped rupture found, both scars ruptured in entire length. Fœtus dead. Placenta over scar.

(40) Coullie. *Ind. Med. Gaz.*, June, 1911. Aged 29, 4-para. Contracted pelvis. (1) 1906, premature labour, dead birth. (2) Cæsarean section, December 2, 1907, after forceps failed. (3) 1909, delivery by podalic version, dead birth. (4) Rupture of scar, December 12, 1910; walked into ward and said she had started labour four hours before; no collapse, hardly any pain; laparotomy; dead fœtus and placenta in peritoneal cavity; hysterectomy, death. Scar ruptured in entire length.

(41) Engström. *Mitteilung. aus der gynaek. Klin.*, 1911, ix, p. 383. Aged 27, 2-para. Contracted pelvis. (1) Cæsarean section, January 28, 1906, at term, in labour, anterior median incision; sutured with four deep fine silk sutures and a number of deep catgut sutures; peritoneal layer with continuous catgut; afebrile recovery. (2) Rupture of the scar, December 26, 1908, at term, in first stage of labour, cervix admitting one finger, the second Cæsarean section was performed; scar covered with adherent omentum; on separating adhesions a rupture was revealed in upper part of thin scar; incision and rupture sutured with catgut and silk; recovery. Child alive. Placenta not attached over the scar.

(42) Jeannin. *L'Obstétrique*, 1911, p. 316. Aged 31, 2-para. Contracted pelvis. (1) Cæsarean section, August 28, 1909, at term, in labour; anterior median incision, sutured with deep interrupted sutures of reindeer tendon and interrupted catgut sutures for peritoneum; afebrile recovery. (2) Rupture of scar, September 24, 1910, at eight and a half months, in labour; cord prolapsed and pulseless; rupture occurred just as craniotomy was about to be performed; laparotomy; fœtus and placenta in abdominal cavity; subtotal hysterectomy, recovery. Scar ruptured in its whole length; placenta inserted under the scar (or at its edge).

(43) Schick. *Deutsch. med. Wochenschr.*, 1911, xxxvii, p. 1690. 3-para. (1) Cæsarean section, November 18, 1906, not in labour, for eclampsia; transverse fundal incision; twin pregnancy; incision sutured with two layers silk, interrupted deep and continuous for peritoneum; afebrile recovery. (2) Delivery by natural passages, January 28, 1910, at term; child delivered by internal version; manual removal of placenta, normal peurperium. (3) Rupture of scar, May 1, 1911, at term, during labour, owing to signs of fœtal distress at end of first stage of labour;

child delivered by internal version; this was done easily and carefully, as possibility of rupturing scar was realized. Soon after delivery, severe hæmorrhage, controlled by ergotin. Placenta retained, hand introduced discovered rupture in fundus. Patient died whilst preparations were being made for laparotomy. Post-mortem: Scar ruptured in entire length, placenta inserted over scar; scar little else than peritoneum.

(44) UNTERBERGER. *Monatsschr. f. Geb. u. Gyn.*, 1911, xxxiv, p. 3. Aged 22, 2-para. (1) July 16, 1908: Cæsarean section for eclampsia; transverse fundal incision; afebrile recovery. (2) Rupture of scar, July 25, 1910, near term, not in labour; severe abdominal pain, and signs of internal hæmorrhage; delivered by anterior vaginal hysterectomy and perforation of fœtal head; after delivery hand in uterus discovered rupture; laparotomy. In spite of afebrile recovery from Cæsarean section there were many firm adhesions between small intestine and fundus uteri. Rupture through whole scar. Subtotal hysterectomy; recovery.

(45) VAGADES. Abstract by Schröder. *Monatsschr. f. Geb. u. Gyn.*, 1916, xliv. Aged 26, 2-para. (1) Cæsarean section, for eclampsia; anterior median incision; febrile recovery with formation of utero-abdominal fistula which closed after a few months. (2) Rupture of scar, one year later, at term, after forty-eight hours of labour, os size of a five-shilling piece; ergot given; laparotomy; intact ovum in peritoneal cavity, very little bleeding; rupture of scar in entire length; edges of scar excised and sutured; recovery. Fœtus dead. Placenta not over scar.

(46) FISCHER, O. *Zeitschr. f. Geb. u. Gyn.*, 1912, lxx, p. 38. 5-para. (1) and (2) Fœtal deaths, intra-partum. (3) March, 1904: Cæsarean section, transverse fundal incision, placenta not in incision; sutured with two deep interrupted silk sutures, not including decidua, and three continuous layers of catgut, of which the third was seroserous: sepsis, raised temperature for nine days and suppuration in abdominal wound. (4) December, 1905: Cæsarean section, scar thin and retracted, firm adhesions to omentum; incision through scar, edges freshened before suture with four deep interrupted silk sutures and three layers of catgut, decidua not included; no rise of temperature during convalescence. (5) November 17, 1911: Rupture of uterus, at thirty-six weeks, not in labour; owing to delayed diagnosis was not sent to hospital and operated on until November 22, 1911; macerated fœtus and placenta free in peritoneal cavity; subtotal hysterectomy, death. Specimen: Scar ruptured in entire length; scar in placental site; complete failure of muscle union; ruptured part very thin and consisted of peritoneum and decidua with a little intervening fibrous tissue: the broad ununited muscle surfaces were covered with decidua continuous with that lining the thin ruptured part. Scar in placental site.

(47) HARRAR. *Amer. Journ. Obst.*, 1912, lxv, p. 808. Aged 35, 8-para. Contracted pelvis. (1) to (6) Two spontaneous deliveries with living children, one living child, and three dead births with instruments. (7) Cæsarean

section, May 15, 1908, at term, in first stage of labour, with ruptured membranes; anterior median incision; febrile recovery. (8) Rupture of scar, May, 1910; second Cæsarean section, at term, in first stage of labour, os size of florin, membranes intact; rupture 4 cm. long at lower end of scar, through which placenta protruded; rent enlarged, and living child extracted; edges excised, sutured; recovery.

(48) HARRAR. *Amer. Journ. Obst.*, 1912, lxv, p. 808. Aged 37, 5-para. Contracted pelvis. (1) Instrumental, dead birth. (2) Cæsarean section, August 25, 1905, at term, in labour many hours with attempts at delivery with forceps and replacement of prolapsed cord; anterior median incision; placenta beneath incision; severe sepsis during recovery. (3) Cæsarean section, November 15, 1907, early in labour. (4) Cæsarean section, December 3, 1908: Many adhesions, febrile recovery. (5) Rupture of scar, January, 1911; was brought up to hospital at end of eleventh lunar month of pregnancy in state of collapse, which came on after a few pains; laparotomy; very large dead fœtus and placenta in abdominal cavity; hysterectomy, death. Examination of uterus showed that rupture did not involve a scar, but had taken place between two of them, through apparently normal uterine muscle.

(49) HARRAR. *Amer. Journ. Obst.*, 1912, lxv, p. 808. Aged 25, 3-para. Contracted pelvis. (1) High forceps, 1906. (2) Cæsarean section, December 23, 1907, in labour at term, anterior median incision, placenta beneath incision; febrile recovery; purulent discharge from uterus, baby got gonococcal ophthalmia. (3) Rupture of scar, January 9, 1909, found at second Cæsarean section, at term, in first stage of labour, with os size of florin and membranes intact; rupture 3 cm. long at lower end of scar, through which membranes bulged; scar incised and living child extracted: edges of scar and rupture excised and sutured; recovery.

(50) JOLLY. *Zeitschr. f. Geb. u. Gyn.*, 1912, lxxi. Aged 27, 4-para. Contracted pelvis. (1) and (2) Dead births. (3) Cæsarean section; anterior placenta diagnosed so posterior median incision made; incision sutured with deep interrupted catgut for muscle, and continuous catgut for peritoneum; febrile convalescence. (4) Six months later again pregnant; rupture of uterus, at term, early in labour. The rupture occurred while patient was being prepared for pre-arranged second Cæsarean section; fœtus and placenta free in peritoneal cavity; infant alive; subtotal hysterectomy, recovery. Specimen: Rupture in upper half of scar; in lower half of old incision no trace of scar visible, the muscle fibres had completely regenerated; in upper half complete failure of muscle union, in the thin scar, decidua lay close to peritoneum with a little intervening scar tissue.

(51) JOSEPHSON. *Gyn. Rundschau*, 1912. Aged 24, 2-para. (1) Cæsarean section for obstructing dermoid cyst of ovary; anterior median incision; recovery febrile; formation of utero-abdominal fistula. (2) Rupture of scar, three years later, at term, collapse and severe symptoms; laparotomy; fœtus and placenta still in uterus; subtotal hysterectomy, recovery. Fœtus dead. Rupture of scar in entire length.

(52) RAMOS. *Revue de la Chir. Obst. et Gyn.*, January and February, 1912; abstract in *Zeitschr. f. Gyn.*, 1913, No. 8. 2-para. (1) Cæsarean section for eclampsia; transverse fundal incision sutured with deep interrupted silk; febrile recovery and bursting of abdominal wound. (2) Rupture of scar one and a half years after Cæsarean section, in eighth month of pregnancy, not in labour; laparotomy; fœtus and placenta in intact membranes free in peritoneal cavity; subtotal hysterectomy, recovery. Fœtus dead. Shock and signs of internal hæmorrhage absent.

(53) SCHWARTZ. *Monatsschr. f. Geb. u. Gyn.*, 1912, xxxv, p. 651. Aged 30, 2-para. (1) Cæsarean section, December 24, 1907, for eclampsia, in eighth month, not in labour: transverse fundal incision, sutured with three layers of catgut, interrupted deep and seromuscular, and continuous peritoneal; suppuration of abdominal wound. (2) Rupture of scar, July 5, 1911; seven months pregnant, not in labour; symptoms of gradual onset during two days, eventually collapse, evidently from completion of rupture; laparotomy; intact ovum in peritoneal cavity. Subtotal hysterectomy, recovery. Fœtus dead. Rupture of scar in entire length.

(54) VARALDO. *Ginecologia Moderna*, 1912, No. 10; abstract in *Zentralbl. f. Gyn.*, 1913, xxxvii, p. 1734. Aged 34. Contracted pelvis. One Cæsarean section, transverse fundal incision. One year later, premature labour induced in eighth month. After pains for twenty-four hours, they ceased, but for some time no disturbing symptoms. Laparotomy; intact ovum in peritoneal cavity, fœtus dead; subtotal hysterectomy, recovery. Placenta over scar, which was ruptured in entire length; almost complete absence of muscular union.

(55) WYSS. *Beiträge z. Geb. u. Gyn.*, 1912, xvii, p. 338. Aged 27, 2-para. (1) December 12, 1908: Cæsarean section for nephritis and œdema of vulva, at term, not in labour; anterior median incision; uterus sutured with deep interrupted silk and continuous silk for peritoneum; sepsis, abdominal wound burst, intestines escaped, resutured, persistence of stitch sinuses for many months. (2) June 30, 1910: Rupture of uterus, at thirty-eight weeks, not in labour; fœtus and placenta still in uterus; subtotal hysterectomy; recovery. Very large fœtus, 5,750 grm., dead. Specimen: Perfect muscular union in lower half of scar, in upper half complete absence of muscular union. Scar consisted of decidua and peritoneum with a few intervening connective tissue fibres; scar in placental site; villi in places penetrated deeply into the scar tissue beneath the peritoneum; omentum adherent to ruptured part.

(56) WYSS. *Beiträge z. Geb. u. Gyn.*, 1912, xvii, p. 344. Aged 26, 2-para. (1) March 27, 1905: Cæsarean section for contracted pelvis, at term, in labour; anterior median incision; placenta under incision, sutured with deep interrupted linen-thread, catgut for peritoneum; sepsis, "endometritis putrida," stitch-abscesses, ventral hernia; linen-thread sutures removed from interior of uterus by curetting on September 28, 1906. (2) June 24, 1908: Rupture of scar, unsuspected, discovered at second Cæsarean section; perforation size of split pea found in scar, with blood flowing from it; child removed through transverse

fundal incision; subtotal hysterectomy, recovery. Child alive. Specimen: Two paper-thin areas in scar, lower one had ruptured; elsewhere scar thick and solid; thin areas consisted of peritoneum and decidua with intervening fibrous tissue. Scar in placental site.

(57) CHIARABBA. Torino: *Tip. G.U. Cassone Succ.*, 1913, xiii; abstract in *Zentralbl. f. d. gesammte Gyn. u. Geb.*, 1914, iv, p. 589. Aged 29, 2-para. (1) Cæsarean section. (2) Rupture of scar two years later; patient got sudden pain and collapse, and died very soon. Post-mortem showed complete rupture of scar, with fœtus and much blood in peritoneal cavity. No further details.

(58) DAVIS, ASA B. *Trans. Amer. Assoc. Obst. and Gyn.*, 1913, xxvi, p. 43. 2-para. Contracted pelvis. (1) Cæsarean section, January 2, 1910, convalescence afebrile. (2) Rupture of scar, 1913, at term, in labour for eleven hours. Dead fœtus, placenta and much blood in peritoneal cavity; laparotomy; suture of rupture. Death.

(59) DAVIS, C. H. *Surg., Gyn. and Obst.*, July, 1913. Aged 37, 3-para. Albuminuria of pregnancy. (1) Cæsarean section; anterior median incision. (2) Forceps. (3) Rupture of scar, not in labour, May 26, 1910. Patient had albuminuria and severe toxæmia. Introduction of de Ribes' bag, after four hours of labour pains bag removed, cervix dilated manually; shoulder presentation found, fœtus delivered by version. Patient died just after delivery. Post-mortem: Large irregular tear found through scar of former Cæsarean section; placenta lay in torn area.

(60) EVERKE. *Monatsschr. f. Geb. u. Gyn.*, 1913, xxxvii, p. 238. 2-para. Cæsarean section for contracted pelvis; transverse fundal incision; febrile recovery. (2) Four years later, rupture of scar at the end of pregnancy, shortly after onset of labour; fœtus and placenta, as an intact ovum, in peritoneal cavity; subtotal hysterectomy, recovery. Whole length of scar ruptured; complete failure of muscle union; union of peritoneum only.

(61) LÜSEBRINK. *Monatsschr. f. Geb. u. Gyn.*, 1913, xxxvii, p. 238. 2-para. (1) Cæsarean section for contracted pelvis, in labour, after attempted delivery by version; febrile recovery. (2) Rupture of scar; labour induced fourteen days prematurely, followed by version and delivery; rupture discovered when hand introduced to remove placenta; subtotal hysterectomy. (No further details.)

(62) RESINELLI. *Rendiconti d. tosc. di ost. e gin.*, iv and v, xxxviii; abstract in *Monatsschr. f. Geb. u. Gyn.*, 1913, p. 201. 5-para. Contracted pelvis. Fourth pregnancy terminated by Cæsarean section; sagittal fundal incision (Caruso); febrile recovery. Rupture of uterus one year later, during labour with strong pains. Laparotomy; subtotal hysterectomy, recovery. Fœtus dead.

(63) APEPLEGATE, 1914. Personal communication to Palmer Findlay, *Amer. Journ. Obst.*, Sept., 1916. Aged 30, 2-para. Contracted pelvis. (1) Cæsarean section, anterior median incision, febrile recovery. (2) Rupture of scar, eighteen months later; hysterectomy, death. Fœtus dead.

(64) BREITSTEIN. *Journ. Amer. Med. Assoc.*, 1914, lxii, p. 689. Aged 21, 3-para. (1) Cæsarean section, March 29, 1909, for large hæmatoma blocking pelvic canal, at term, in labour; anterior median incision, sutured with two layers of interrupted chromic catgut, deep and superficial; febrile recovery and profuse purulent vaginal discharge, and stitch abscess in abdominal wound. (2) October 29, 1911: Spontaneous delivery by natural passages at term; normal puerperium. (3) Rupture of uterus, June 8, 1913, at thirty-six weeks; uncertain whether in labour or not; no collapse. Operation: Complete ovum with intact membranes free in abdominal cavity; no free blood in abdomen; supravaginal hysterectomy, recovery. Fœtus dead. Scar ruptured in entire length.

(65) FRANZ, 1914. Personal observation by Palmer Findlay. *Amer. Journ. Obst.*, Sept., 1916. Aged 24, 2-para. Contracted pelvis. (1) Cæsarean section, 1913; anterior median incision. (2) Rupture of scar, 1914; placenta prævia in seventh month; insertion of hydrostatic bag, rupture followed in half an hour; hysterectomy, death. Fœtus dead. Rupture of whole length of scar; placenta not over scar.

(66) ENDELMANN. *Gyn. Rundschau*, 1914. Aged 44, 2-para. (1) Cæsarean section for cicatricial stricture of cervix; anterior median incision, sutured in two layers; prolonged febrile recovery. (2) Rupture of scar, five years later, at term; no symptoms, rupture discovered at second Cæsarean section; subtotal hysterectomy, recovery. Living child. Partial rupture 3 cm. long, through which fœtal membranes projected, covered with adherent omentum.

(67) HILLIS, D. S., 1914. Personal communication to Palmer Findlay. *Amer. Journ. Obst.*, Sept., 1916. 2-para. (1) Cæsarean section for eclampsia; anterior median incision, sutured with three layers of catgut. (2) Rupture of scar two hours after onset of labour; laparotomy; rupture sutured, recovery. Fœtus dead. Rupture through entire length of scar.

(68) MILLER, JEFF, 1914. Personal communication to Palmer Findlay. *Amer. Journ. Obst.*, Sept., 1916. Aged 30, 2-para. Contracted pelvis. (1) Cæsarean section at term, in labour; anterior median incision, sutured with three layers of twenty-day catgut; febrile recovery. (2) Rupture of scar, one year and three months later, in labour at term; rupture occurred on operation table in preparation for Cæsarean section; laparotomy; suture of rupture; death from shock in three hours. Fœtus dead. Placenta implanted over scar.

(69) SHAW. *Journ. Obst. and Gyn. of Brit. Emp.*, 1814, xxvi, Oct.-Dec. Cæsarean section twenty months previously; anterior median incision, sutured with four to six silk sutures through whole thickness of uterine wall and filled in with intermediate catgut sutures; rupture occurred when within a week of full term; sudden severe pain and collapse; laparotomy; whole scar ruptured and blocked by placenta, which was adherent all around it; dead fœtus removed through rupture; subtotal hysterectomy, recovery.

(70) Walls. *Journ. Obst. and Gyn. of Brit. Emp.*, 1914, xxvi, Oct.-Dec. Aged 33. Contracted pelvis. Three Cæsarean sections, the last in October, 1913; anterior median incision, sutured with chromic catgut, and intermediate plain catgut suture. On November 23, 1914, when seven months pregnant, got sudden abdominal pain and collapse; laparotomy; much blood in peritoneal cavity oozing through scar; placenta beneath scar plainly seen; hysterectomy, death.

(71) Walls. *Journ. Obst. and Gyn. of Brit. Emp.*, 1914, xxvi, Oct.-Dec, Contracted pelvis. Previous Cæsarean section, anterior median incision, sutured with chromic catgut, and intermediate plain catgut sutures. Was to have second Cæsarean section in ten days' time, but symptoms of accidental hæmorrhage began. Laparotomy; scar wide and thin, blood oozing from its lower end; dead fœtus delivered by incision through scar; subtotal hysterectomy.

(72) Wolff. *Zeitschr. f. Geb. u. Gyn.*, 1914, cxxv, p. 740. 3-para. (1) ? (2) June 21, 1912: Cæsarean section for contracted pelvis; in labour; transperitoneal operation, longitudinal incision through cervix extending slightly upwards on to body of uterus; incision sutured with two layers of continuous catgut and continuous catgut for peritoneum; sepsis, formation of pus-discharging fistula at lower end of wound. (3) June 16, 1913: Rupture of uterus at term, in first stage of labour; os about three-fifths dilated: fœtus and placenta still in uterus: total hysterectomy after delivery of fœtus and placenta; recovered. Fœtus dead. Specimen: Rupture of scar in entire length; scar tissue very thin; decidua separated from peritoneum by a fibromuscular layer 3 to 4 mm. thick; presence of decidua cells in the muscle very striking.

(73) Eberhart. *Deutsch. med. Wochenschr.*, 1915, xli, p. 662. Contracted pelvis. Cæsarean section by transverse fundal incision, sutured with catgut; rupture of scar three and a half years later, early in labour: typical symptoms of complete rupture; laparotomy; fœtus, placenta and much blood in peritoneal cavity; subtotal hysterectomy, recovery. Fœtus dead. Rupture of scar in entire length, only peritoneum healed; many adhesions between scar and bowel and omentum.

(74) Miller, Jeff, 1915. Personal communication to Palmer Findlay. *Amer. Journ. Obst.*, Sept., 1916. Aged 18, 2-para. Contracted pelvis. (1) Cæsarean section; anterior median incision, febrile recovery. (2) Rupture of scar one year later, in labour at term; entered hospital after prolonged labour; pituitrin had been given prior to rupture; laparotomy; suture of rupture, recovery. Fœtus dead. Placenta not over scar.

(75) Williams, J. W. *Bull. Johns Hopkins Hosp.*, 1917, xxviii, No. 321, p. 335. 3-para. Contracted pelvis. Cæsarean section, anterior median incision, febrile recovery. Rupture of scar one year and two months later at seventh month. Rupture probably occurred two days before operation; no symptoms suggestive of rupture; intact ovum in peritoneal cavity: subtotal hysterectomy, recovery. Fœtus dead.

(76) BELL, J. N. *Amer. Journ. Obst.*, December, 1916. Aged 27, 2-para. (1) March 19, 1914: Cæsarean section for eclampsia; no details stated; febrile recovery. (2) October 16, 1915: Rupture of uterus at thirty-seven weeks, not in labour; subtotal hysterectomy. Patient died. Fœtus dead. Specimen: Imperfect description.

(77) RONGY, A. J. *Amer. Journ. Obst.*, December, 1916. Aged 22, 2-para. (1) Cæsarean section, no details. (2) July 24, 1913; rupture of uterus at thirty-two weeks, not in labour; scar had given way entirely; rent sutured; death from septic peritonitis. Fœtus dead. Specimen not described.

(78) RONGY, A. J. *Amer. Journ. Obst.*, December, 1916. Aged 28, 2-para. (1) 1914, Cæsarean section, no details. (2) July 11, 1916; rupture of uterus; placenta presenting through ruptured scar; subtotal hysterectomy, recovery. Fœtus dead. Specimen not described.

(79) MARTIN, A. *Monatsschr. f. Geb. u. Gyn.*, 1916, xliv, p. 296. Aged 26, 3-para. (1) Normal labour, 1898. (2) Cæsarean section, January 24, 1904, at seven months, not in labour. Laparotomy was done "for severe symptoms of chronic pelvic peritonitis of obscure origin"; why uterus was at same time emptied by Cæsarean section is not clear. Transverse fundal incision, sutured with three layers of catgut: febrile recovery. (3) Rupture of scar, July 22, 1906, not in labour; laparotomy; intact ovum, with much blood, in peritoneal cavity; scar ruptured in whole length; rupture sutured; recovery. Fœtus dead. This patient after having been seized with severe pain and vomiting, was driven in a cart twenty-five miles to the hospital, and arrived in very fair condition. After the escape of the ovum into the peritoneal cavity bleeding had ceased, for at the operation no blood was coming from edges of rupture or from placental site.

(80) SCHROEDER (1). *Monatsschr. f. Geb. u. Gyn.*, 1916, xliv, p. 191. Aged 42, 5-para. Contracted pelvis. (1) Long labour, dead birth. (2) Natural labour, living child. (3) Forceps, living child. (4) Cæsarean section, June 12, 1902, after labour had lasted twenty-four hours and head had failed to engage; transverse fundal incision; placenta beneath incision, sutured with three layers of catgut; febrile recovery. In 1911 abortion at five months. (5) Rupture of scar, March 17, 1913, at term, in labour six hours. Rupture unsuspected and discovered at second Cæsarean section, placenta projecting through scar ruptured in entire length; much fresh blood in peritoneal cavity. Child alive. Subtotal hysterectomy, recovery.

(81) SCHROEDER (2). *Monatsschr. f. Geb. u. Gyn.*, 1916, xliv, p. 191. Aged 41, 4-para. Contracted pelvis. (1) Induction of premature labour, live birth. (2) Induction of premature labour, dead birth. (3) Cæsarean section, at term transverse fundal incision, sutured with two layers of catgut; afebrile recovery. (4) Rupture of scar two years later, discovered at second Cæsarean section at term, early in labour. There were no signs nor symptoms, and rupture was unsuspected. Rupture found in part of scar, through which placental tissue

was projecting; whilst uterus was being eventrated the whole scar burst and intact ovum was projected out of the uterus. Child alive. Edges of rupture excised and sutured; recovery.

(82) VON FRANQUÉ. *Monatsschr. f. Geb. u. Gyn.*, 1916, xliv, p. 186. Aged 29, 3-para. Contracted pelvis. (1) Forceps, dead birth. (2) Cæsarean section, August 7, 1913, at term, early in labour; transverse fundal incision, sutured with two layers catgut, deep interrupted and continuous peritoneal; afebrile recovery. (3) Rupture of scar, April 3, 1916, at eight months, early in first stage of labour, discovered during second Cæsarean section. A tense, cyst-like swelling protruded through one side of the scar; at first taken for an ovarian cyst, but really a herniated bag of fœtal membranes. Uterus incised; living fœtus; subtotal hysterectomy, recovery. Scar showed union of peritoneum only. Edge of placenta just overlapped site of scar.

(83) CROSLAND. *Brit. Med. Journ.*, 1917, ii, p. 790. Aged 30. Contracted pelvis. Cæsarean section, April 1913; rupture of scar, incomplete, July, 1917, in labour, early in first stage; no pain, no collapse, abdomen rather tender; rupture not suspected, discovered at second Cæsarean section; across lower third of scar was a large subperitoneal hæmatoma, extending into the broad ligaments; this was a subperitoneal rupture of the scar; living child and placenta extracted: incision and rupture sutured; recovery.

(84) SPALDING. *Journ. Amer. Med. Assoc.*, 1917, lxix, p. 184. Aged 32, 3-para. Contracted pelvis. (1) High forceps; dead fœtus, 1911. (2) Cæsarean section, 1913, afebrile recovery. In 1914 cervix was amputated. (3) 1916, breech labour, fœtal distress; pituitary extract given, causing severe labour pains; owing to impossibility of extracting head, body was severed, leaving head in uterus. Patient became collapsed, and there was continuous hæmorrhage. Owing to absence of craniotomy instruments, hysterectomy performed, and patient died. Examination of specimen showed placenta beneath scar. At one part of the old scar, muscle tissue thinned down to a hair-like line, beneath which was a layer of hæmorrhage which overlaid the villi, with the peritoneal coat ruptured.

(85) WING, L. A. *Amer. Journ. Obst.*, March, 1917. Aged 53, 2-para. (1) 1915, Cæsarean section for concealed accidental hæmorrhage, at thirty-five weeks, not in labour; site of incision and suture material not stated; febrile convalescence for first five days; abdominal wound healed by first intention. (2) 1916, eleven months after operation rupture of uterus, at end of seventh month, not in labour; accidental hæmorrhage, partly external and partly concealed; much free blood in abdominal cavity, uterine scar ruptured in entire length, placenta protruding through rent; fœtus still in uterus, membranes intact; scar excised and sutured; recovery. Specimen: Scar thin in several places; on maternal surface of placenta was a sharply defined blood clot 7 cm. by 8 cm. in area and 1 cm. to 2 cm. in thickness. Rupture probably due to increased pressure from retroplacental hæmorrhage.

(86) DAVIS, ASA B. *Amer. Journ. Obst.*, 1918, lxxvii, p. 136. 5-para. Contracted pelvis. (1) Instrumental labour, 1907. (2) Instrumental labour, 1908. (3) Delivery by internal version and breech extraction. (4) Cæsarean section, May 25, 1914, in labour a month before term; anterior median incision, sutured with two layers of chromic catgut; placenta not in incision, fœtus macerated; febrile recovery. (5) Rupture of scar, November 23, 1916, at term, very early in labour. None of usual symptoms of rupture, which was discovered at operation for repeated Cæsarean section. Before operation examination showed cervix high, and uterus could not be outlined. No presenting part found. What was taken to be an ovarian cyst was found in front of uterus, "it changed its shape and position as the position of the patient changed. In the dorsal position it would flatten and spread across the abdomen. In the lateral position it assumed a large, globular, clearly outlined shape." Beyond being unduly sensitive to abdominal pressure, the patient had no symptoms. On opening abdomen a sac of membranes was seen filled with clear fluid in which fœtal small parts were seen moving actively. Membranes ruptured, living child extracted. The uterus was contracted, and well down in lower abdomen; "it was drawn up to the abdominal opening and found wide open throughout the entire length of the Cæsarean section scar. The edges of this opening were thick and entirely covered with adherent membranes. The placenta was in posterior and upper part of uterine cavity, somewhat to right; no blood and no raw surfaces. All evidence pointed to fact that this opening had existed from before conception or very soon after, and that for many months or during the entire pregnancy the ovum had developed outside the uterine cavity. The membranes were not unusually thick and tough. It was wonderful that a slight fall or a misstep of the mother had not ruptured them." Edges of rupture excised and sutured; recovery.

(87) DAVIS, ASA B. *Amer. Journ. Obst.*, 1918, lxxvii, p. 136. Aged 26, 2-para. Contracted pelvis. (1) Cæsarean section, July 9, 1912, in labour, at term; anterior median incision, sutured with two layers interrupted chromic catgut, through whole thickness of wall, buried by continuous suture of chromic catgut; placenta not in incision; recovery, slightly febrile. (2) Rupture of scar, January 15, 1915, at term, not in labour, severe collapse; laparotomy; dead fœtus and placenta and much blood removed from peritoneal cavity; rupture of scar in entire length, edges of rupture excised and sutured; slightly febrile recovery. (3) Second Cæsarean section, September 7, 1917; labour pains had just started, twenty-seven days before calculated date of term; incision through old scar, which was thick and strong and found with difficulty, slightly adherent to abdominal wall, with placenta directly beneath it. Uneventful recovery.

(88) DE COURCY. *Journ. Amer. Med. Assoc.*, 1918, lxx, p. 840. Aged 33, 4-para. Contracted pelvis. (1) Craniotomy. (2) Difficult live birth. (3) Cæsarean section, June 4, 1916, anterior median incision; incision over placenta. (4) Rupture of scar, October 18, 1917, at eighth month, not in

labour; collapse; laparotomy: intact ovum in peritoneal cavity; subtotal hysterectomy, death. Fœtus dead. Scar ruptured in whole length.

(89) De Courcy. *Journ. Amer. Med. Assoc.*, 1918, lxx, p. 840. Aged 28, 2-para. Contracted pelvis. (1) Cæsarean section, 1910, anterior median incision. (2) Rupture of uterus, October 28, 1916, at term, in labour six hours, os fully dilated; sudden pain and collapse, died very quickly. Post-mortem: Dead fœtus and placenta free in peritoneal cavity; scar ruptured in whole length.

(90) Howson, C. R. *Journ. Amer. Med. Assoc.*, August 31, 1918, p. 728. Aged 24. Delivered by Cæsarean section nine months previous to the rupture; recovery good except for slight suppuration in abdominal wound. At time of rupture patient was seven months pregnant, and not in labour. Died before operation. Post-mortem: Fundal portion of scar found ruptured; fœtus and placenta, with intact membranes, free in abdominal cavity; very little intraperitoneal hæmorrhage.

(91) Novak, E. *Journ. Amer. Med. Assoc.*, July 13, 1918, p. 105. Aged 19, 2-para. (1) Cæsarean section, May 5, 1916, for eclampsia, in labour; recovery good, except for slight infection of abdominal wound. (2) Rupture of scar at term, early in labour. After a few labour pains patient was seized with severe abdominal pain and rigidity; this pain lasted a few days, with fever, after which patient became comfortable and "was able to get round fairly comfortably." Six weeks after these events, owing to supposed protraction of pregnancy, careful examination led to diagnosis of rupture of uterus. Laparotomy; macerated fœtus and placenta with intact membranes in the peritoneal cavity; no intraperitoneal hæmorrhage; subtotal hysterectomy; recovery. In involuted uterus was a rent the size of the former scar.

(92) Dorman. *Amer. Journ. Obst.*, 1919, p. 670. Aged 28, 3-para. Contracted pelvis. (1) 1916, dead birth. (2) Cæsarean section, July 31, 1917, at term, after test-labour of twelve hours; anterior median incision, sutured with two layers of continuous plain catgut and by Lembert peritoneal suture; febrile recovery. (3) Rupture of scar, January 6, 1919, at term, not in labour; sudden onset of pain; no collapse; laparotomy; dead fœtus and placenta free in peritoneal cavity; rupture sutured; recovery. Rupture of entire length of scar.

(93-97) Cases personally reported.

Composite Table made up of Lists sent for the Collective Investigation. The Lists stand in the same order as in Table I in the Text. The numbers refer to Patients.

Abbreviations used :—

C.P. = contracted pelvis.
C.S. = Cæsarean section.
D. = died.
D.B. = dead-birth (still-birth).

E.P. = extra-peritoneal.
L.U.S. = lower uterine segment.
c.g. = catgut.
con. = continuous.

in. = interrupted.
mat. = mattress.
mod. = moderate.
s.w.g. = silk worm gut.
thr. = linen thread.

The eighteen cases of ruptured scar will be found as under: St. Mary's Hospital, Manchester, No. 190; Glasgow Royal Maternity and Women's Hospital, No. 82; Liverpool Maternity Hospital, Nos. 81, 82, 83; Jessop Hospital, Sheffield; Nos. 102, 103, 104, 105; Leeds Maternity Hospital, No. 63; London Hospital, Nos. 34, 49, 50, 51, 52; Middlesex Hospital, No. 30; St. Thomas's Hospital, No. 27; Rotunda Hospital, No. 21.

St. Mary's Hospital, Manchester	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	C.P.	37	6	Yes	Median	—	2 layers catgut	Moderate	Alive and well	No precautions
	2	,,	,,	30	1	No	,,	—	,, ,,	Slight	,,	,,
	3	,,	,,	38	10	Yes	,,	—	,, ,,	,,	D.B.	Died 1919
	4	1913	Acc. hæm.	29	2	No (34 weeks)	,,	—	,, silk	Moderate	,,	Died 1917
	5	,,	C.P.	30	1	No	,,	—	,, ,,	Severe	Alive and well	No precautions
	6	,,	,,	33	7	,,	,,	—	,, catgut	O	,,	,,
	7	,,	,,	29	2	,,	,,	—	,, ,,	O	D. convs.	,,
	8	,,	,,	42	7	,,	,,	—	,, ,,	O	Alive and well	,,
	9	,,	Large children	36	2	,,	,,	—	,, ,,	O	D. later	,,
	10	1914	C.P.	25	3	,,	,,	—	,, ,,	O	Alive and well	Husband abroad
	11	,,	Cardiac	27	1	,, (34 weeks)	,,	—	,, ,,	O	D. 3 months	Died 1915, cardiac
	12	,,	C.P.	29	1	Yes	,,	—	,, ,,	Slight	D. impf. anus	No precautions
	13	,,	,,	33	2	No	,,	—	,, ,,	,,	Alive and well	,,
	14	,,	,,	36	2	Yes	,,	—	,, ,,	,,	,,	,,
	15	,,	Fibroid	38	1	,,	,,	—	,, ,,	Severe	,,	,,

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
St. Mary's Hospital, Manchester (*continued*).	16	1914	C.P.	26	1	Yes	Median	—	2 layers catgut	Moderate	Alive	No precautions
	17	,,	,,	37	2	No	,,	—	,, ,,	O	D. 7 weeks	,,
	18	,,	,,	25	3	Yes	,,	—	,, ,,	Slight	Alive and well	,,
	19	,,	,,	27	2	,,	,,	—	,, ,,	,,	Alive	,,
	20	,,	,,	36	3	,,	,,	—	,, ,,	,,	Alive and well	Precautions
	21	,,	,,	32	4	No	,,	—	,, ,,	Severe	,,	Widow
	22	1915	,,	18	1	,,	,,	—	,, ,,	Moderate	,,	No precautions
	23	,,	,,	22	1	,,	,,	—	,, ,,	Slight	,,	Widow
	24	,,	,,	32	2	,,	,,	—	,, ,,	O	Alive	No precautions
	[25]	,,	,,	27	1	,,	,,	—	,, ,,	Mammary abscess	Alive and well	,,
	26	,,	,,	28	1	,,	,,	—	,, ,,	Slight	,,	,,
No subsequent pregnancy	27	,,	,,	23	2	,,	,,	—	,, ,,	Moderate	Died	,,
	28	,,	,,	24	3	,,	,,	—	,, ,,	O	Alive and well	Precautions
	29	,,	,,	27	2	,,	,,	—	,, ,,	Moderate	,,	No precautions
	30	,,	,,	30	2	,,	,,	—	,, ,,	O	,,	Precautions
	31	,,	,,	34	5	,,	,,	—	,, ,,	O	,,	,,
	32	,,	,,	30	1	,,	,,	—	,, ,,	O	,,	No precautions
	33	,,	,,	23	2	,,	,,	—	,, ,,	Moderate	,,	,,
	34	,,	,,	35	3	,,	,,	—	,, ,,	O	,,	,,
	35	,,	,,	31	1	,,	,,	—	,, ,,	O	,,	,,
	36	,,	,,	27	1	,,	,,	—	,, ,,	Slight	,,	Widow
	37	,,	,,	38	2	,,	,,	—	,, ,,	O	,,	Precautions
	38	,,	,,	30	1	,,	,,	—	,, ,,	Slight	,,	No precautions
	39	,,	,,	25	1	,,	,,	—	,, ,,	Moderate	Died later	,,
	40	,,	Ovarian cyst	22	1	Yes	,,	—	,, ,,	,,	Alive and well	,,
	41	,,	C. P.	25	2	No	,,	—	,, ,,	Slight	,,	Precautions
	42	1916	,,	35	3	,,	,,	—	,, ,,	,,	,,	No precautions
	43	,,	,,	40	4	,,	,,	—	,, ,,	O	,,	Precautions
	44	,,	,,	34	2	,,	,,	—	,, ,,	O	,,	No precautions
	45	,,	,,	37	7	,,	,,	—	,, ,,	Slight	,,	,,
	46	,,	,,	29	1	,,	,,	—	,, ,,	,,	,,	Precautions
	47	,,	,,	42	1	,,	,,	—	,, ,,	O	,,	No precautions
	48	,,	,,	34	1	,,	,,	—	,, ,,	Slight	,,	,,
	49	,,	,,	27	2	,,	,,	—	,, ,,	,,	,,	Precautions
	50	,,	Plac. prævia	31	1	,, (34 weeks)	,,	—	,, ,,	Moderate	,,	,,
	51	,,	C. P.	38	8	No	,,	—	,, ,,	O	,,	No precautions

No subsequent pregnancy	52	,,	,,	45	1	Yes	,,	—	,,	,,	Slight	,,	,,
	53	,,	,,	24	2	No	,,	—	,,	,,	,,	,,	,,
	54	,,	,,	24	1	Yes	,,	—	,,	,,	,,	,,	,,
	55	,,	Fibroid	36	3	No	,,	—	,,	,,	O	,,	,,
	56	1917	C. P.	38	2	,,	,,	—	,,	,,	O	,,	,,
	57	,,	,,	42	4	,,	,,	—	,,	,,	O	,,	Precautions
	58	,,	,,	37	1	,,	,,	—	,,	,,	O	,,	No precautions
	59	,,	,,	33	3	,,	,,	—	,,	,,	Slight	,,	Widow
	60	,,	,,	23	1	,,	,,	—	,,	,,	O	,,	No precautions
	61	,,	,,	29	2	,,	,,	—	,,	,,	O	,,	,,
	62	,,	,,	33	3	Yes	,,	—	,,	,,	O	,,	Precautions
	63	,,	,,	31	2	No	,,	—	,,	,,	O	,,	,,
	64	,,	,,	42	4	,,	,,	—	,,	,,	Slight	,,	,,
	65	,,	,,	22	1	,,	,,	—	,,	,,	,,	,,	No precautions
	66	,,	,,	30	5	Yes	,,	—	,,	,,	,,	,,	,,
	67	,,	,,	38	2	No	,,	—	,,	,,	,,	,,	,,
	68	,,	,,	23	3	,,	,,	—	,,	,,	Moderate	,,	,,
	69	,,	,,	27	1	,,	,,	—	,,	,,	O	,,	,,
	70	,,	,,	27	1	Yes	,,	—	,,	,,	Slight	,,	,,
	71	,,	,,	34	3	,,	,,	—	,,	,,	O	,,	Precautions
	72	,,	,,	27	2	No	,,	—	,,	,,	O	,,	,,
	73	1918	,,	23	3	,,	,,	—	,,	,,	Slight	,,	No precautions
	74	,,	,,	42	5	,,	,,	—	,,	,,	O	,,	,,
	75	,,	,,	25	3	Yes	,,	—	,,	,,	Severe	,,	,,
	76	,,	,,	25	1	,,	,,	—	,,	,,	,,	,,	,,
	77	,,	,,	26	2	,,	,,	—	,,	,,	Slight	,,	Precautions
	78	,,	,,	29	2	No	,,	—	,,	,,	O	,,	No precautions
	79	,,	,,	36	7	Yes	,,	—	,,	,,	Moderate	Died	Precautions
	80	,,	,,	28	1	No	,,	—	,,	,,	Severe	Alive and well	No precautions
	81	,,	,,	40	1	Yes	,,	—	,,	,,	O	Died	,,
	82	,,	,,	33	3	,,	,,	—	,,	,,	Slight	Alive and well	,,
	83	,,	,,	40	3	,,	,,	—	,,	,,	,,	,,	,,
	84	,,	Plac. prævia	33	1	No	,,	—	,,	,,	,,	,,	Precautions
	85	,,	C.P.	23	1	,,	,,	—	,,	,,	,,	,,	No precautions
	86	,,	,,	34	3	,,	,,	—	,,	,,	O	,,	,,
	87	,,	Ventral hernia	34	1	Yes	,,	—	,,	,,	O	Died	,,
	88	,,	C.P.	39	11	,,	,,	—	,,	,,	Slight	Alive and well	,,
	89	,,	Rigid os	37	1	,,	,,	—	,,	,,	,,	,,	Precautions
	90	,,	C.P.	28	1	,,	,,	—	,,	,,	Severe	Died	,,
	91	,,	,,	29	4	,,	,,	—	,,	,,	,,	Alive and well	No precautions
	92	,,	Fibroid	26	3	No	,,	—	,,	,,	O	,,	,,
	93	,,	C.P.	36	1	,,	,,	—	,,	,,	O	,,	,,
	94	,,	,,	29	2	,,	,,	—	,,	,,	O	,,	Precautions
	95	,,	,,	31	4	,,	,,	—	,,	,,	O	,,	No precautions
	96	,,	,,	24	1	Yes	,,	—	,,	,,	O	,,	,,

St. Mary's Hospital, Manchester, (*continued*).	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Delivery by natural passages	97	1912	C.P.	34	7	Yes	Median	—	2 layers catgut	Moderate	Alive and well	1913, instrumental D.B. ; 2nd C.S., 1916
	98	1915	,,	28	2	No	,,	—	,, ,,	Slight	,,	Normal labour since
	99	1917	,,	21	1	,,	,,	—	,, ,,	Moderate	,,	Two normal labours since
Repeated Cæsarean section	100	1912	C.P.	20	2	No	Median	—	2 layers catgut	O	Alive and well	2nd, 1914 ; 3rd, 1919, sterilized ; not in labour ; term
	101	,,	,,	26	1	,,	,,	—	,, ,,	O	,,	2nd, 1914 ; in labour ; term
	102	,,	,,	36	2	,,	,,	—	,, ,,	Slight	Died	2nd, 1915 ; not in labour ; term
	103	,,	,,	20	1	,,	,,	—	,, ,,	O	Alive and well	2nd, 1913 ; 3rd, 1915 ; 4th, 1919 ; not in labour ; term
	104	,,	,,	29	2	,,	,,	—	,, ,,	Moderate	,,	2nd, 1914 ; 3rd, 1918 ; not in labour ; term
	105	,,	,,	26	4	,,	,,	—	,, ,,	,,	,,	2nd, 1916 ; sterilized ; not in labour ; term
	106	,,	,,	22	2	,,	,,	—	,, ,,	Slight	,,	2nd, 1919 ; in labour ; term
	97	,,	,,	34	7	Yes	,,	—	,, ,,	Moderate	,,	2nd, 1916 ; not in labour ; term ; forceps delivery, 1913
	107	,,	,,	31	1	,,	,,	—	,, ,,	Severe	D.B.	2nd, 1914 ; in labour ; term
	108	,,	,,	20	2	No	,,	—	,, ,,	O	Died	2nd, 1914 ; not in labour ; term
	109	,,	,,	32	1	Yes	,,	—	,, ,,	Slight	D.B.	2nd, 1918 ; not in labour ; term
	110	1913	,,	24	2	No	,,	—	,, ,,	Moderate	Alive and well	2nd, 1915 ; not in labour ; term
	111	,,	,,	26	3	,,	,,	—	,, ,,	Slight	,,	2nd, 1918 ; not in labour ; term
	112	,,	,,	31	6	,,	,,	—	,, ,,	Moderate	,,	2nd, 1916 ; not in labour ; term
	113	,,	,,	29	1	,,	,,	—	,, ,,	O	,,	2nd, 1918 ; not in labour ; term
	114	1914	,,	26	1	Yes	,,	—	4 layers silk and catgut	Slight	,,	2nd, 1919 ; not in labour ; term
	115	,,	,,	24	3	No	,,	—	2 layers catgut	,,	,,	2nd, 1916 ; 3rd, 1918 ; not in labour ; term
	116	,,	,,	25	2	,,	,,	—	,, ,,	,,	,,	2nd, 1917 ; not in labour ; term
	117	,,	,,	39	12	Yes	,,	—	,, ,,	,,	,,	2nd, 1919 ; not in labour ; term (died peritonitis)
	118	,,	Large children	33	5	,,	,,	—	,, ,,	O	,,	2nd, 1918 ; not in labour ; term
	119	,,	C.P.	22	1	,,	,,	—	,, ,,	Severe	Died	2nd, 1918 ; not in labour ; term (widow)
	120	,,	,, (eclampsia)	35	7	,,	,,	—	,, ,,	O	Alive and well	2nd, 1917 ; not in labour ; term

Repeated Cæsarean section	121	,,	C.P.	28	1	,,	,,	—	,,	,,	Severe	,,	2nd, 1916 : sterilized ; not in labour ; term
	122	,,	,,	31	3	No	,,	—	,,	,,	Slight	,,	2nd, 1918 ; not in labour ; term
	123	1915	,,	23	1	Yes	,,	—	,,	,,	,,	,,	2nd, 1917 ; 3rd, 1919 ; sterilized ; not in labour ; term
	124	,,	,,	18	1	No	,,	—	,,	,,	Severe	Died	2nd, 1918 ; not in labour ; term ; pregnant now
	125	,,	,,	34	2	,,	,,	—	,,	,,	O	Alive and well	2nd, 1916 ; sterilized ; not in labour ; term
	126	,,	,,	19	1	,,	,,	—	,,	,,	Slight	,,	2nd, 1919 ; not in labour ; term
	127	,,	,,	29	1	Yes	,,	—	,,	,,	O	,,	2nd, 1916 ; sterilized ; not in labour ; term
	128	,,	,,	27	3	No	,,	—	,,	,,	O	,,	2nd, 1917 ; not in labour ; term ; pregnant now
	129	,,	,,	35	2	Yes	,,	—	,,	,,	Moderate	D.B.	2nd, 1916 ; sterilized ; not in labour ; term
	130	,,	,,	34	1	,,	,,	—	,,	,,	Slight	Alive and well	2nd, 1920 ; not in labour ; term
	131	,,	,,	31	5	,,	,,	—	,,	,,	Moderate	,,	2nd, 1916 ; sterilized ; not in labour ; term
	132	,,	,,	19	1	No	,,	—	,,	,,	O	,,	2nd, 1916 ; 3rd, 1917 ; 4th, 1919 ; not in labour ; term
	133	,,	,,	23	3	,,	,,	—	,,	,,	O	,,	2nd, 1917 ; not in labour ; term ; pregnant now
	134	,,	,,	20	1	,,	,,	—	,,	,,	Slight	,,	2nd, 1916 ; 3rd, 1920 ; sterilized ; not in labour ; term
	135	,,	Fibroid	31	1	Yes	,,	—	,,	,,	,,	,,	2nd, 1917 ; not in labour ; term
	136	,,	C.P.	26	3	No	,,	—	,,	,,	Severe	,,	2nd, 1917 ; not in labour ; term
	137	,,	,,	38	9	Yes	,,	—	,,	,,	O	,,	2nd, 1919 ; not in labour ; term
	138	,,	Recto-vaginal fistula, C.P.	25	2	No	,,	—	,,	,,	Slight	,,	2nd, 1920 ; not in labour ; term
	139	,,	C.P.	25	2	,,	,,	—	,,	,,	,,	,,	2nd, 1917 ; 3rd, 1918 ; sterilized ; not in labour ; term
	140	,,	,,	25	3	,,	,,	—	,,	,,	,,	,,	2nd. 1918 ; not in labour ; term
	141	1916	,,	20	1	,,	,,	—	,,	,,	,,	Died	2nd, 1920 ; not in labour ; term
	142	,,	,,	30	4	Yes (34 weeks)	,,	—	,,	,,	?	Alive and well	2nd, 1920 ; not in labour ; term
	143	,,	,,	30	3	No	,,	—	,,	,,	O	Died	2nd, 1918 ; not in labour ; term
	144	,,	,,	25	1	?	,,	—	,,	,,	?	D.B.	2nd, 1918 ; not in labour ; term
	145	,,	,,	22	1	No	,,	—	,,	,,	Moderate	Died	2nd, 1919 ; not in labour ; term
	146	,,	,,	22	1	,,	,,	—	,,	,,	Slight	Alive and well	2nd, 1918 ; 3rd, 1920 ; sterilized ; not in labour ; term
	147	,,	,,	24	3	,,	,,	—	,,	,,	O	Died	2nd, 1917 ; not in labour ; term
	148	,,	,,	21	1	,,	,,	—	,,	,,	O	Alive and well	2nd, 1920 ; not in labour ; term

St. Mary's Hospital, Manchester (*continued*).	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Repeated Cæsarean section	149	1916	C.P.	25	1	No	Median	—	2 layers catgut	O	Alive and well	2nd, 1920; not in labour; term
	150	"	"	28	1	"	"	—	" "	Slight	Alive	2nd, 1917; not in labour term; pregnant now
	151	"	"	34	2	"	"	—	" "	"	Alive and well	2nd, 1919; not in labour; term
	152	1917	"	31	2	"	"	—	" "	"	"	2nd, 1919; sterilized; in labour; term
	153	"	"	31	3	"	"	—	" "	"	"	2nd, 1919; not in labour; term; pregnant now
	154	"	"	22	3	"	"	—	" "	O	"	2nd, 1919; not in labour; term; pregnant now
	155	"	"	22	1	"	"	—	" "	Moderate	"	2nd, 1920; not in labour; term
	156	"	"	29	2	Yes	"	—	" "	Slight	"	2nd, 1919; not in labour; term; (died pneumonia
	157	"	Overdue pregnancy	30	1	"	"	—	" "	O	Monster D.B.	2nd, 1918; not in labour; term
	158	"	C.P.	42	9	"	"	—	" "	Slight	Alive and well	2nd, 1918; not in labour; term
	159	"	"	31	6	No	"	—	" "	"	"	2nd, 1919; sterilized; not in labour; term
	160	"	"	30	1	Yes	"	—	" "	O	"	2nd, 1918; not in labour; term
	161	"	"	21	2	No	"	—	" "	O	"	2nd, 1919; not in labour; term
	162	"	"	17	2	"	"	—	" "	Severe	Died	2nd, 1919; not in labour; term
	163	1918	"	25	1	"	"	—	" "	O	Alive and well	2nd, 1919; not in labour; term
	164	"	"	23	1	"	"	—	" "	O	"	2nd, 1919; not in labour; term
	165	"	"	28	6	"	"	—	" "	Slight	Died	2nd, 1920; sterilized; not in labour; term
	166	"	"	32	4	"	"	—	" "	O	Alive and well	2nd, 1919; not in labour; term
Abortions	104	1912	C.P.	29	2	No	Median	—	2 layers catgut	Moderate	Alive and well	C.S. 1914 and 1918; no date
	108	"	"	20	2	"	"	—	" "	O	Died	C.S. 1914; no date
	167	1914	Large children	41	7	"	"	—	" "	Moderate	Alive and well	Abortion; no date
	168	1915	C.P.	29	1	"	"	—	" "	O	Died	Abortion; no date
	169	"	"	22	1	Yes	"	—	" "	Slight	Alive and well	Abortion; no date; pregnant now
	170	"	"	23	1	No	"	—	" "	Severe	Died	Abortion; no date

Abortions	171	1916	,,	28	5	,,	,,	—	,, ,,	Slight	Alive	Abortion ; no date ; pregnant now
	172	,,	,,	35	2	,,	,,	—	,, ,,	,,	Alive and well	Mole ; B.C.C. cystitis 1917 ; died
	173	,,	,,	28	3	,,	,,	—	,, ,,	,,	,,	3 months abortion ; pregnant now
	174	1917	,,	34	3	,,	,,	—	,, ,,	O	,,	Abortion ; no date
	175	,,	,,	26	2	,,	,,	—	,, ,,	Slight	,,	Abortion ; no date
	176	1918	,,	26	2	,,	,,	—	,, ,,	,,	,,	Abortion ; no date
	177	,,	,,	29	1	Yes	,,	—	,, ,,	O	Died 14th day	Abortion ; no date
Patients now pregnant	178	1915	C.P.	31	3	No	Median	—	2 layers catgut	Moderate	Alive and well	Pregnant 1920
	179	,,	,,	21	1	,,	,,	—	,, ,,	Slight	,,	,,
	124	,,	,,	18	1	,,	,,	—	,, ,,	Severe	,,	C.S. 1918 ; pregnant 1920
	128	,,	,,	27	3	,,	,,	—	,, ,,	O	,,	C.S. 1917 ; ,,
	180	,,	,,	28	2	,,	,,	—	,, ,,	Moderate	,,	1920, pregnant
	133	,,	,,	23	3	,,	,,	—	,, ,,	O	,,	C.S. 1917 ; pregnant 1920
	169	,,	,,	22	1	Yes	,,	—	,, ,,	Slight	,,	1 abortion ; ,,
	181	,,	,,	31	1	No	,,	—	,, ,,	,,	,,	Pregnant 1920
	182	1916	,,	33	3	,,	,,	—	,, ,,	Moderate	Died	,,
	171	,,	,,	28	5	,,	,,	—	,, ,,	Slight	Alive	1 abortion ; pregnant 1920
	150	,,	,,	28	1	,,	,,	—	,, ,,	,,	,,	C.S. 1917 ; ,,
	173	,,	,,	28	3	,,	,,	—	,, ,,	,,	Alive and well	7 months pregnant 1920 ; one (3 months) abortion
	153	1917	,,	31	3	,,	,,	—	,, ,,	,,	,,	C.S. 1919 ; (4 months) pregnant 1920
	154	,,	,,	22	3	,,	,,	—	,, ,,	O	,,	C.S. 1919 ; pregnant 1920
	183	,,	,,	24	4	Yes	,,	—	,, ,,	O	,,	Pregnant 1920
	184	,,	,,	23	1	No	,,	—	,, ,,	Slight	Died	,,
	185	,,	,,	22	2	,,	,,	—	,, ,,	O	Alive and well	,,
	186	1918	,,	31	3	Yes	,,	—	,, ,,	O	,,	,,
	187	,,	,,	36	3	,,	,,	—	,, ,,	O	,,	2 months pregnant 1920
	188	,,	,,	27	2	,,	,,	—	, ,,	Slight	,,	Pregnant 1920
	189	,,	,,	28	4	,,	,,	—	,, ,,	Moderate	Died	,,
Rupture of scar	190	1916	Ovarian cyst	21	1	Yes	Median	—	2 layers catgut	Slight	Alive	Uterus ruptured while in hospital ; patient died of hæmorrhage and shock

QUEEN CHARLOTTE'S HOSPITAL, LONDON

No subsequent pregnancy

No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
1	1913	Eclampsia	—	1	Yes	Median	—	Double silk	Moderate	Alive and well	Precautions
2	,,	Fibroid	—	1	,,	,,	—	,, ,,	O	,,	,,
3	,,	C.P.	—	2	No	,,	—	,, catgut	Moderate	,,	,,
4	,,	,,	—	1	Yes	,,	—	In. s.w.g.	Slight	,,	
5	1914	,,	—	3	?	,,	—	,, silk	,,	,,	,,
6	1915	,,	43	1	,,	,,	—	Double silk	Moderate	,,	Husband in Salonika
7	,,	Eclampsia	44	3	No	,,	—	,, ,,	O	,,	Husband dead
8	,,	,,	20	1	Yes	,,	—	,, ,,	Severe	D. 1 year	Husband died 1916
9	,,	,,	19	1	,,	,,	—	,, ,,	Moderate	D. 7 weeks	Husband killed 1917
10	,,	C.P.	37	1	No	,,	—	In. s.w.g.	O	Alive and well	
11	,,	,,	31	1	,,	,,	—	,, silk	O	,,	Husband died 1915
12	,,	,,	43	1	Yes	,,	—	?	Slight	,,	Precautions
13	1916	,,	38	1	,,	,,	—	Double silk	,,	,,	,,
14	,,	Eclampsia	45	7	,,	,,	—	,, ,,	Moderate	,,	
15	,,	C.P.	42	1	,,	,,	—	?	,,	,,	
16	,,	,,	34	2	,,	,,	—	Double silk	Slight	,,	Husband killed 1916
17	,,	,,	30	1	,,	,,	—	in. ,,	O		
18	,,	Plac. prævia	20	1	,,	,,	—	,, ,,	O	Died	
19	,,	Fibroids	39	1	,,	,,	—	,, ,,	Moderate	D.B.	Husband away till 1919
20	,,	C.P.	26	1	,,	,,	—	,, ,,	Slight	Alive and well	Precautions
21	,,	,,	30	2	,,	,,	—	Double ,,	O	,,	Husband killed 1918
22	,,	,,	38	3	,,	,,	—	,, s.w.g.	O	,,	
23	1917	Plac. prævia	37	2	?	,,	—	in. silk	O	,,	Precautions
24	,,	C.P.	39	5	?	,,	—	,, ,,	O	,,	,,
25	,,	,,	40	4	No	,,	—	Double ,,	O	,,	Husband killed 1917
26	,,	,,	31	1	Yes	,,	—	,, ,,	O	,,	
27	,,	,,	24	2	,,	,,	—	,, ,,	O	D. 14 months	Husband died 1917
28	,,	,,	28	2	,,	,,	—	,, ,,	O	Alive and well	
29	,,	Eclampsia	30	2	,,	,,	—	,, ,,	O	,,	Precautions
30	,,	C.P.	28	2	,,	,,	—	,, s.w.g.	O	,,	Husband died 1918
31	,,	,,	23	1	,,	,,	—	?	O	D. 4 months	Husband killed 5 months later
32	,,	,,	30	1	,,	,,	—	?	O	Alive and well	Precautions
33	,,	,,	27	1	No	,,	—	In. silk	O	,,	
34	,,	,,	22	1		,,	—	?	O	,,	
35	,,	,,	40	2	No	,,	—	Double silk	O	,,	
36	,,	,,	39	3	Yes	,,	—	,, ,,	O	,,	

No subsequent pregnancy	37	1917	C.P.	27	1	Yes	Median	—	Double silk	O	Alive and well	Precautions
	38	,,	,,	19	1	,,	,,	—	,, ,,	O	,,	,,
	39	1918	,,	25	2	No	,,	—	,, ,,	O	,,	,,
	40	,,	,,	27	1	,,	,,	—	,, s.w.g.	O	,,	
	41	,,	Plac. prævia	31	2	,,	,,	—	,, silk	O	,,	Precautions
	42	,,	C.P.	37	1	,,	,,	—	,, ,,	O	,,	
	43	,,	,,	23	1	,,	,,	—	,, ,,	O	,,	Precautions
	44	,,	Eclampsia	24	1	,,	,,	—	,, ,,	O	D. 6 weeks	
	45	,,	,,	38	4	Yes	,,	—	In. silk	O	D.B.	Precautions
	46	,,	C.P.	34	2	,,	,,	—	,, s.w.g.	O	Alive and well	
	47	,,	,,	25	2		,,	—	,, silk	O	D.B.	
	48	,,	,,	31	1	No	,,	—	,, ,,	O	Alive and well	
	49	,,	Eclampsia	20	1	,,	,,	—	,, ,,	O	,,	Precautions
Delivery by natural passages	50	1914	C.P.	—	2	Yes	,,	—	?	Moderate	Alive and well	1 Induction, 1917
	51	1915	Eclampsia	22	1	,,	,,	—	?	Slight	,,	1 ,, 1919
	52	,,	,,	21	1	?	,,	—	In. silk	Severe	,,	1 ,, 1916
	53	1916	,,	26	1	,,	,,	—	,, ,,	Slight	D.B.	1 ,, 1918
	54	,,	C.P.	24	2	,,	,,	—	Double ,,	,,	Alive and well	2 normally since, ?
	55	1918	,,	22	1	,,	,,	—	,, ,,		D. 6 weeks	1 ,, 1919
	56	1916	,,	25	4	,,	,,	—	,, ,,	,,	D. 3½ months	1 by forceps after pubiotomy
Abortions	57	1916	C.P.	26	1	Yes	,,	—	Double silk	O	Alive and well	Miscarriage, 1919
	58	,,	,,	34	2	,,	,,	—	In. ,,	Slight	,,	,, ,,
Pregnant now	59	1914	C.P.	—	5	Yes	,,	—	In. silk	Slight	Alive and well	
	60	1916	,,	28	1	,,	,,	—	Double s.w.g	,,	,,	
	61	,,	,,	27	1	,,	,,	—	,, silk	Moderate	Died	
	62	1917	,,	20	1	,,	,,	—	In. ,,	O	Alive and well	
	63	,,	,,	29	2	,,	,,	—	Double silk	Moderate	,,	
	64	1918	,,	26	2	,,	,,	—	,,	O	,,	
	65	1916	,,	28	3	,,	,,	—	,,	Slight	,,	3 months miscarriage, 1919, and is 2 months pregnant now

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
QUEEN CHARLOTTE'S HOSPITAL, LONDON (*continued*). Repeated Cæsarean section	66	1912	C.P.	?	1	Yes	Median	—	Double silk	Slight	Died	2nd, 1915, then sterilized
	67	,,	,,	—	1	,,	,,	—	,,	Moderate	Alive and well	2nd, 1914 ,,
	68	,,	,,	—	2	,,	,,	—	,,	O	,,	2nd, 1914, 2 miscarriages
	69	,,	,,	25	3	,,	,,	—	,,	Slight	,,	2nd, 1914, 3rd, 1915
	70	1913	,,	22	1	No	,,	—	Double catgut	O	,,	2nd, 1916, then sterilized
	71	,,	,,	32	2	Yes	,,	—	,, silk	Slight	,,	2nd, 1916, then husband died
	72	1914	,,	21	1	,,	,,	—	In. ,,	Severe	D.B.	2nd, 1916, then sterilized
	73	,,	,,	—	3	,,	,,	—	,, ,,	Slight	Alive and well	2nd, 1919
	74	,,	,,	30	1	,,	,,	—	2 layers in. catgut	O	,,	2nd, 1918
	75	1915	,,	30	1	,,	,,	—	Double silk	O	,,	2nd, 1918
	76	,,	,,	23	1	No	,,	—	,,	Slight	,,	2nd, 1917, then sterilized
	77	,,	,,	35	5	Yes	,,	—	In. ,,	,,	,,	2nd, 1917
	78	,,	,,	39	6	,,	,,	—	Double ,,	,,	,,	2nd, 1919
	79	1916	,,	23	1	,,	,,	—	,,	Severe	,,	2nd, 1918, then sterilized
	80	,,	,,	26	1	No	,,	—	,,	Moderate	Died 1 year	2nd, 1920
	81	,,	,,	36	4	Yes	,,	—	,,	Slight	Died	2nd, 1920, then sterilized
	82	,,	,,	24	1	,,	,,	—	,,	O	Alive and well	2nd, 1920
	83	,,	,,	39	1	,,	,,	—	,,	Moderate	,,	2nd, 1919
	84	,,	,,	24	1	No	,,	—	,,	Slight	,,	2nd, 1918
	85	,,	,,	30	2	,,	,,	—	Double s.w.g.	O	,,	2nd, 1918; takes precautions
	86	1917	,,	24	1	Yes	,,	—	,, silk	Severe	Died	2nd, 1919
	87	1914	,,	25	2	,,	,,	—	,, ,,	Slight	Alive and well	2nd, 1917
	88	,,	,,	25	2	,,	,,	—	,, ,,	O	,,	2nd, 1917

Glasgow Royal Maternity and Women's Hospital	1	1913	C.P.	26	3	No	Median	A.	Silk	2 days	Alive and well	
	2	,,	,,	31	1	Yes	,,	?	In. silk, con. c.g.	4 ,,	,,	
	3	,,	C.P. eclamptic	19	1	No (36 weeks)	,,	?	Double con. c.g.	6 ,,	D.B.	
	4	,,	C.P.	33	3	Yes	,,	?	,,	O	Alive and well	
	5	,,	,,	?	3	,,	,,	?	Double catgut	O	D. 4 months	Child died aged 4 months
	6	1914	,,	31	1	,,	E.P.	?	?	O	Alive and well	
	7	,,	,,	29	1	,,	Median	?	In. silk, con. c.g.	8 days	,,	
	8	,,	,,	22	1	,,	,,	?	,,	3 ,,	,,	Patient has since died
	9	,,	,,	30	2	,,	,,	A.	Silk	2 ,,	,,	
	10	,,	G.C.P.	37	1	,,	,,	?	Double con. c.g.	O	,,	
	11	1915	C.P.	35	1	,,	,,	?	?	O	,,	
	12	,,	,,	31	1	,,	,,	A.	Silk	O	,,	
	13	,,	Cardiac	28	1	No (36 weeks)	,,	?	Double con. c.g.	O	?	Patient has since died
No subsequent pregnancy	14	,,	C.P.	23	3	Yes	,,	A.	,,	O	,,	
	15	1916	,,	35	1	,,	,,	?	In. silk, con. c.g.	O	D.B.	
	16	,,	,,	24	2	No	L.U.S.	?	Double con. c.g.	3 days	Alive and well	
	17	,,	,,	17	1	Yes	Median	A.	,,	1 ,,	D. 1 year	
	18	,,	,,	27	2	,,	,,	?	,,	O	Alive and well	
	19	1917	,,	17	1	,,	,,	?	Silk	O	D.	
	20	,,	,,	32	4	,,	,,	?	In. silk, con. c.g.	O	D, 1 month	Baby died aged 1 month
	21	,,	,,	20	1	,,	,,	?	Double con. c.g.	O	Alive and well	
	22	,,	,,	23	2	,,	E.P.	?	?	O	,,	
	23	,,	,,	28	1	,,	Median	?	In. silk, con. c.g.	O	,,	
	24	1918	,,	27	1	,,	,,	A.	Double con. c.g.	O	,,	
	25	,,	,,	28	2	,,	,,	P.	3 layers catgut	O	,,	
	26	,,	,,	28	3	,,	L.U.S.	P.	In. silk, con. c.g	O	,,	
	27	,,	,,	21	1	,,	,,	P.	,,	22 severe	,,	
	28	,,	,,	31	3	,,	Median	P.	In. c.g., con. c.g.	7 & 8 slight	,,	Abdom : wound broke down
	29	,,	Fibroids	42	1	,, (8 months)	,,	P.	In. silk, con. c.g.	O	,,	
	30	,,	C.P.	32	2	Yes	,,	?	Double con. c.g.	O	,,	
	31	,,	,,	28	1	,,	L.U.S.	?	?	1, 2 & 8, slight	,,	
	32	,,	,,	25	3	,,	Median	?	In. silk, con. c.g.	O	,,	
	33	,,	,,	29	1	,,	,,	P.	,,	O	,,	
	34	,,	,,	32	1	,,	,,	?	Silk	O	D.B.	Cord prolapsed
	35	,,	C.P. appendicitis	31	2	No (8 months)	,,	P.	In. silk, con. c.g.	O	Alive and well	Appendectomy
	36	,,	C.P.	30	8	Yes	,,	?	Double con. c.g.	O	,,	
	37	,,	,,	19	1	,,	,,	?	In. silk, con. c.g	O	,,	
	38	,,	,,	28	1	,,	,,	P.	Double con. c.g.	5th day	,,	
	39	,,	,,	22	1	,,	,,	?	?	4 ,,	,,	
	40	1919	,,	22	1	,,	,,	?	In. silk, con. c.g.	O	D.	

Repeated Cæsarean section

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
GLASGOW ROYAL MATERNITY AND WOMEN'S HOSPITAL (*continued*).	41	1912	C.P.	24	2	Yes	Median	?	Double con. c.g.	O	Alive and well	2nd, 1913
	42	,,	,,	41	1	,,	Trans. fundal	?	In. silk, con. c.g.	3rd and 4th day	,,	2nd, 1914 ; scar very thin
	43	,,	,,	24	4	,,	Median	?	Double con. c.g.	O	,,	2nd, 1914
	44	,,	,,	37	4	,,	Trans. fundal	?	Interrupted silk	7 days	,,	2nd, 1914, 6½ lb ; natural delivery one year later
	45	,,	,,	28	4	,,	Median	?	Double con. c.g.	2 days	,,	2nd, 1914
	46	,,	,,	20	1	,,	,,	?	,,	O	,,	2nd, 1915
	47	1914	,,	21	1	,,	E.P.	?	,,	O	,,	2nd, 1916
	48	1916	,,	27	1	,,	Median	?	In. silk, con. c.g.	5 days	,,	2nd, 1918
	49	1915	,,	?	?	?	?	?	Double con. c.g.	O	,,	2nd, 1916
	50	1912	,,	32	1	Yes	Median	?	,,	5, 6 and 7th day	,,	2nd, 1916 ; mother died after second operation
	51	,,	,,	28	3	,,	,,	?	In. silk, con. c.g.	2 days	,,	1st, 1912 ; second miscarriage
	52	,,	,,	23	2	,,	,,	?	,,	O	,,	2nd, 1914
	53	1913	,,	24	4	No	,,	?	,,	O	,,	1st, 1912
	54	1916	,,	20	1	Yes	Median	P.	,,	4 days	,,	2nd, 1917
	55	1913	,,	24	1	,,	,,	A.	Double con. c.g.	10 days	,,	2nd, 1916
	56	1912	G.C.P.	29	1	,,	,,	?	In. silk, con. c.g.	O	,,	2nd, 1917
	57	,,	C.P.	25	3	,,	,,	?	,,	O	,,	1st, 1914
	58	1916	,,	30	2	,,	,,	A.	Double con. c.g.	O	,,	2nd, 1917
	59	1914	,,	30	4	No	,,	P.	,,	10th day	,,	2nd, 1918
	60	,,	G.C.P.	30	3	Yes	L.U.S.	P.	In. silk, con. c.g.	4th day	,,	1st, 1912 ; craniotomy 1917
	61	1915	C.P.	30	1	,,	Median	P.	Double con. c.g.	2 days	,,	2nd, 1918
	62	,,	,,	22	2	,,	,,	P.	,,	O	,,	1st, 1918
	63	,,	,,	27	2	,,	,,	?	?	Slight	,,	1st, 1912
	64	1916	,,	30	2	,,	L.U.S.	?	In. silk, con. c.g.	O	,,	2nd, 1918
	65	1915	,,	35	1	,,	,,	?	,,	O	Alive and well	2nd, 1919
	66	1917	,,	23	1	,,	,,	?	Double con. c.g.	O	,,	2nd, 1919
	67	,,	,,	23	1	,,	,,	?	,,	O	,,	2nd, 1919
	68	,,	,,	26	2	,,	,,	P.	?	O	,,	2nd, 1919
	69	1918	,,	34	5	Yes (36 weeks)	,,	P.	Double con. c.g.	O	D.B.	2nd, 1920
	70	,,	,,	32	1	Yes	,,	?	?	O	,,	2nd, 1919
	71	1920	,,	26	2	,,	,,	P.	Double con. c.g.	O	Alive and well	1st, 1914

Abortion (See also No. 51)	72	1915	Obstructing tumour	37	6	No	Median	?	Double con. c.g.	Slight	Alive and well	Since C.S. 2 abortions, both 2 months
	73	1917	C.P.	28	1	Yes (28 weeks)	,,	?	,,	O	D. same day	2½ months early, 1919
	74	1918	,,	21	1	Yes	,,	?	In. silk, con. c.g.	5th day slight	Alive and well	Child died, 6 weeks abortion June 1919
Delivery by natural passages (See also Nos. 44 and 60)	75	1915	C.P.	33	2	Yes	Median	?	Double con. c.g.	O	Alive and well	Child born normally 1920
	76	,,	,,	21	1	,,	,,	?	In. silk, con. c.g.	5th day	,,	7 months child 1917 (forceps); 9 months breech S.B. 1919
	77	1916	,,	19	1	,,	,,	A.	Double con. c.g.	O	,,	Normal delivery followed
Now pregnant	78	1915	C.P.	31	3	Yes	Median	?	Double con. c.g.	O	Alive and well	8 months
	79	1918	,,	21	1	,,	,,	?	In. silk, con. c.g.	5, 8 and 9th days slight	,,	3 months
	80	,,	,,	38	3	,,	L.U.S.	?	?	O	,,	6 months
	81	,,	,,	36	2	,,	,,	P.	In. silk, con. c.g.	O	,,	8 months
Rupture of scar	82	1915	C.P.	28	1	Yes (30 weeks)	Median	?	Double con. c.g.	O	D. 1 week	Spontaneous rupture at 7th month 1917; hysterectomy, recovery

LIVERPOOL MATERNITY HOSPITAL	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	Carcinoma recti	41	10	Yes	Median	P.	Con. catgut	Slight	Alive and well	Died 6 mon. after operation
	2	1913	C.P.	42	4	,,	,,	?	,, ,,	O	,,	Precautions
	3	,,	,,	27	5	,,	,,	A.	,, ,,	O	,,	Precautions
	4	,,	,,	29	2	,,	,,	A.	,, ,,	O	,,	D. 2 years later; pneumonia
	5	,,	,,	36	9	,,	,,	?	,, ,,	O	,	Precautions
	6	,,	,,	31	3	,,	,,	A.	,, ,,	Slight	,,	Precautions
	7	1914	Ovarian tumour	27	2	,,	,,	?	,, ,,	,,	,,	Patient died 4 years later
	8	,,	,,	33	1	,,	,,	?	,, ,,	O	,,	Precautions
	9	,	C.P.	33	3	,,	,,	P.	,, ,,	O	,,	No precautions
	10	,,	,,	34	2	No	,,	P.	,, ,,	O	,,	Precautions
	11	,,	,,	35	1	Yes	,,	P.	,, ,,	O	,,	Patient died 1 year later
	12	,,	,,	24	1	No	,,	P.	,, ,,	O	,,	Precautions
	13	1916	,,	42	6	Yes (38 weeks)	,,	?	,, ,,	O	,,	No precautions
	14	,,	Ovarian cyst	27	2	No	,,	P.	,, ,,	O	,,	No precautions
	15	,,	C.P.	28	5	Yes	,,	P.	,, ,,	Slight	,,	No precautions
	16	,,	,,	33	5	No	,,	P.	,, ,,	O	,,	Precautions
	17	,,	,,	37	8	,,	,,	A.	,, ,,	Moderate	,,	Husband died 1 month before Cæsarean section
	18	1917	,,	29	4	Yes	,,	A.	,, ,,	O	,,	No precautions
	19	1918	,,	25	1	,,	,,	P.	,, ,,	O	,,	Husband killed 4 months before Cæsarean section
	20	,,	?	21	2	,,	,,	A.	,, ,,	Slight	,,	Precautions
	21	,,	C P.	24	1	,,	,,	P.	,, ,,	,,	,,	No precautions
	22	,,	,,	24	2	No	,,	?	,, ,,	O	,,	Precautions
	23	,,	,,	24	2	Yes	,,	P.	,, ,,	O	,,	No precautions
	24	,,	Concealed A.P.H.	30	7	,,	,,	?	,, ,,	Slight	D.B.	Precautions
	25	,,	C.P.	38	7	,,	,,	?	,, ,,	,,	Alive and well	Precautions
	26	,,	,,	19	1	,,	,,	A.	,, ,	,,	,,	Precautions
	27	,,	,,	24	1	,,	,,	P.	,, ,,	O	,,	No precautions
	28	,,	,,	25	1	,,	,,	?	,, ,,	Slight	,,	Widow for 18 months
	29	,,	,,	37	2	,,	,,	A.	,, ,,	O	,,	Precautions
	30	,,	,,	40	11	,,	,,	A.	,, ,,	O	,,	Precautions

Delivery by natural passages	31	1913	C.P.	20	1	Yes	Median	P.	Con. catgut	O	Alive and well	Induction, 1914, 38 weeks, 8 lb. 1 oz.; 1917, 36 weeks, 5 lb. 8 oz.
	32	1914	,,	28	1	,,	,,	A.	,, ,,	O	,,	Induction, 1919, 37 weeks, 7 lb. 15 oz.
	33	1915	,,	29	2	,,	,,	A.	,, ,,	O	,,	Normal delivery, 1919, 7 lb.
	34	,,	,,	39	2	,,	,,	P.	,, ,,	O	,,	Forceps delivery, 1917; lived 4 days
	35	1916	,,	24	3	No	,,	A.	,, ,,	?	,,	7 months premature labour; stillborn, 1919
	36	1918	,,	25	3	,,	,,	?	,, ,,	Slight	,,	Induction, 1919, 38 weeks, 7 lb. 1 oz.
	37	1917	,,	29	1	,,	,,	P.	,, ,,	O	,,	1 stillbirth; is now pregnant
Repeated Cæsarean section	38	1912	C.P.	29	2	No	Median	?	Con. catgut	O	Alive and well	1913; at term, not in labour
	39	,,	,,	32	4	,,	,,	A.	,, ,,	O	,,	1916; at term, not in labour
	40	,,	,,	27	5	Yes	,,	?	,, ,,	O	,,	1915; at term, in labour
	41	,,	,,	20	1	No	,,	P.	,, ,,	O	,,	1918; at term, in labour
	42	1913	,,	39	7	,,	,,	A.	,, ,,	O	,,	1914; at term, not in labour
	43	,,	,,	31	1	Yes	,,	P.	,, ,,	O	,,	1917; at term, not in labour
	44	,,	,,	26	3	,,	,,	?	,, ,,	O	,,	1918; at term, in labour; baby died at 6 weeks
	45	1914	,,	33	1	,,	,,	?	,, ,,	O	,,	1917; at term, not in labour
	46	,,	,,	36	1	,,	,,	?	,, ,,	O	,,	1915; at term, not in labour
	47	,,	,,	27	4	,,	,,	?	,, ,,	O	,,	1918; at term, in labour
	48	,,	,,	25	3	No	,,	P.	,, ,,	O	,,	1917; at term, in labour
	49	1915	,,	32	5	,,	,,	?	,, ,,	O	,,	1917; at term, in labour; sterilized
	50	,,	,,	29	5	Yes	,,	?	,, ,,	O	,,	1918; at term, in labour
	51	,,	,,	28	1	,,	,,	P.	3 layers catgut; 4 s.w.g.	Moderate	,,	1918; at term, in labour
	52	,,	,,	21	1	,,	,,	?	Con. catgut	Slight	D.B.	1916; at term, in labour
	53	1916	,,	31	4	,,	,,	P.	,, ,,	O	D. 9 days	1917; at term, not in labour
	54	,,	,,	26	1	No	,,	P.	Buried catgut in 3 layers	Slight	Alive and well	1918; at term, not in labour
	55	,,	,,	28	5	Yes	,,	P.	Con. catgut	Slight	,,	1918; at term, not in labour
	56	1917	,,	28	4	No	,,	A.	3 layers catgut; 3 s.w.g.	O	,,	1918; at term, not in labour
	57	,,	,,	22	1	,,	,,	P.	Con. catgut	Moderate	,,	1918; at term, in labour

LIVERPOOL MATERNITY HOSPITAL (*continued*)	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Repeated Cæsarean section	58	1917	C.P.	29	3	Yes	Median	P.	Con. catgut	O	Alive and well (Twins)	1918 ; at term, not in labour
	59	1918	,,	33	8	,,	,,	P.	,, ,,	O	Alive and well	
	60	1916	Con. pelvis	21	1	No	,,	A.	,, ,,	Slight	Lived 2 hours	Had further C.S. in London, 1918
	61	1912	C.P.	26	2	Yes	,,	A.	,, ,,	Moderate	Alive and well	2nd, 1914 ; at term, not in labour ; 3rd, 1917
	62	,,	,,	22	3	,,	,,	A.	,, ,	Slight	,,	2nd, 1916 ; at term, in labour ; 3rd, 1917 ; at term, in labour
	63	,,	,,	26	2	No	,,	?	,, ,,	?	,,	2nd, 1914 ; at term, in labour ; 3rd, 1917 ; at term, in labour ; sterilized
	64	,,	,,	25	4	Yes	,,	?	,, ,,	?	,,	2nd, 1915 ; at term, in labour ; 3rd, 1917; at term, in labour ; sterilized
	65	1913	,,	27	2	,,	,,	?	,, ,,	?	,,	2nd, 1914 ; 3rd. 1917 ; at term, in labour ; sterilized
	66	,,	,,	26	2	No (38 weeks)	,,	?	,, ,,	O	,,	2nd,1914 ; at term ; 3rd, 1917 ; at term, in labour
(See also No. 83, case of ruptured scar).	67	1915	,,	21	1	No	,,	A.	,, ,,	O	,,	2nd, 1918 ; at term, not in labour ; 3rd, 1920 ; at term, not in labour ; sterilized
Abortion	68	1917	C.P.	31	1	Yes (38 weeks)	Median	P.	Con. catgut	O	Alive and well	Abortion 3 months, 1920
	69	1918	,,	23	1	No	,,	P.	,, ,,	Moderate	,,	Abortion 10 weeks, 1919
Now pregnant	70	1915	C.P.	35	5	Yes	Median	?	Con. catgut	O	Alive and well	November, 1919
	71	1916	,,	23	3	No	,,	?	,, ,,	Moderate	,,	December, 1919
	72	,,	,,	27	1	Yes (37 weeks)	,,	?	,, ,,	,,	,,	December, 1919
	73	,,	,,	26	2	Yes	,,	P.	,, ,,	Slight	,,	October, 1919

Now pregnant	74	,,	,,	24	3	No	,,	A.	,, ,,	O	,,	December, 1919
	75	1917	,,	20	1	Yes (38 weeks)	,,	A.	,, ,,	Slight	,,	November, 1919
	76	,,	,,	37	7	No	,,	P.	,, ,,	O	,,	August, 1919
	77	1918	,,	25	3	No (38 weeks)	,,	?	,, ,,	O	Died 9 days	January, 1920
	78	,,	,,	38	12	Yes	,,	A.	,, ,,	O	Alive and well	August, 1919
	79	,,	,,	36	4	No	,,	P.	,, ,,	O	,,	August, 1919
See also No. 37)	80	,,	,,	23	2	,,	,,	P.	,, ,,	O	,,	
Rupture of scar	81	1912	C.P.	30	8	Yes	Median	?	Con. catgut	O	Alive and well	Rupture of scar in 1915 ; died
	82	,,	,,	37	7	,,	,,	?	,, ,,	Slight	,,	Induction, 1913; rupture of uterus slight through old C.S. scar ; hysterectomy, general peritonitis; died 5 days later ; child died
	83	1914	,,	25	3	No	,,	P.	,, ,,	Slight	,,	2nd C.S., 1917 ; rupture of scar 1919 ; 35 weeks ; male, stillborn, 6 lbs. 10 oz.
Jessop Hospital for Women, Sheffield No subsequent pregnancy	1	1913	C.P.	38	4	No	Median	A	in. c.g., con. c.g.	Slight	Alive and well	
	2	,,	,,	27	3	,,	,,	?	in. thr., con. c.g.	,,	D. 13 months	
	3	,,	,,	31	3	Yes	,,	?	in. c.g., con. c.g.	,,	Alive and well	
	4	,,	,,	34	2	,,	,,	?	in. thr., con. c.g.	O	,,	
	5	,,	,,	32	4	,,	,,	?	in. c.g., con. c.g.	Slight	,,	
	6	,,	Large baby	24	2	,,	,,	?	in. thr., con. c.g.	Severe	,,	
	7	1914	C P.	29	5	,,	,,	?	in. c.g., con. c.g.	Moderate	,,	
	8	,,	,,	24	1	,,	,,	?	,, ,,	Slight	D. 4¾ months	
	9	,,	,,	22	1	,,	,,	?	in. thr., con. c.g.	Moderate	Alive and well	
	10	,,	,,	35	5	,,	,,	?	,, ,,	,,	,,	
	11	,,	,,	33	1	No	,,	?	in. c.g., con. c.g.	Slight	,,	
	12	,,	,,	30	1	Yes	,,	?	,, ,,	,,	,,	Husband killed
	13	,,	,,	25	3	,, (36 weeks)	,,	?	,, ,,	,,	D. 15 hours	
	14	,,	,,	40	8	Yes	,,	A	,, ,,	,,	Alive and well	
	15	..	,,	30	3	,,	,,	?	,, ,,	,,	,,	
	16	1915	,,	25	3	,,	,,	A	,, ,,	,,	,,	
	17	,,	,,	36	10	,,	,,	A	in. thr., con. c.g.	,,	,,	

Jessop Hospital for Women, Sheffield (*continued*).	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	18	1915	C.P.	30	1	Yes	Median	A	in. c.g., con. c.g.	Slight	Alive and well	
	19	,,	,,	27	2	,, (36 weeks)	,,	P	,, ,,	,,	,,	
	20	,,	,,	34	1	Yes	,,	A	,, ,,	,,	,,	
	21	,,	Heart disease	28	2	,,	,,	?	,, ,,	,,	,,	Precautions
	22	,,	C.P.	24	1	,,	,,	?	,, ,,	,,	,,	
	23	,,	,,	39	6	,,	,,	?	in. thr., con. c.g.	,,	,,	,,
	24	,,	Carc. of cervix	41	3	No (38 weeks)	,,	A	in. c.g., con. c.g.	,,	D. 8 days	M. died January, 1917
	25	,,	C.P.	30	4	Yes	,,	A	in. thr., con. c.g.	O	Alive and well	Takes precautions
	26	1916	,,	39	3	,,	,,	?	in. c.g., con. c.g.	O	,,	,,
	27	,,	,,	37	3	,,	,,	L	,, ,,	Slight	,,	
	28	,,	,,	24	1	,,	,,	A	,, ,,	,,	,,	
	29	,,	,,	40	6	,, (38 weeks)	,,	P	,, ,,	O	,,	Husband dead 2 years
	30	,,	,,	38	1	Yes	,,	L	,, ,,	Slight	D. 10 days	
	31	,,	,,	23	1	,,	,,	A	,, ,,	,,	Alive and well	
	32	,,	,,	34	2	,,	,,	?	,, ,,	O	,,	Precautions
	33	1917	,,	24	3	,,	,,	?	in. thr., con. c.g.	Slight	D. 2 months	,,
	34	,,	,,	24	2	,,	,,	?	in. c.g., con. c.g.	O	Alive and well	
	35	,,	,,	23	1	,,	,,	?	,, ,,	Slight	,,	
	36	,,	,,	30	1	,,	,,	?	in. thr., con. c.g.	,,	,,	,,
	37	,,	,,	30	3	,,	,,	?	in. c.g., con. c.g.	O	,,	
	38	,,	,,	37	1	,,	,,	?	in. thr., con. c.g.	O	,,	
	39	,,	,,	39	3	,,	,,	?	,, ,,	O	,,	,,
	40	,,	,,	30	7	,,	,,	?	in. c.g., con. c.g.	O	D. 1 year	,,
	41	,,	,,	40	2	,, (38 weeks)	,,	?	,, ,,	Slight	Alive and well	
	42	,,	,,	26	2	Yes	,,	?	,, ,,	O	,,	
	43	1918	,,	39	4	,,	,,	?	in. thr., con. c.g.	O	,,	
	44	,,	,,	33	5	,,	,,	?	in. c.g., con. c.g.	O	,,	,,
	45	,,	,,	32	1	,,	,,	?	,, ,,	O	,,	,,
	46	,,	,,	31	1	,,	,,	?	,, ,,	Slight	,,	,,
	47	,,	,,	29	3	,,	,,	?	in. thr., con. c.g.	O	,,	,,
	48	,,	,,	23	3	,,	,,	?	in. c.g., con. c.g.	Slight	,,	
	49	,,	,,	24	2	,,	,,	?	in. thr., con. c.g.	,,	,,	Hysterectomy February, 1919
	50	,,	4 months Ectopic. pgy. obstr. deliv.	28	1	,,	,,	?	,, ,,	O	,,	R. tube and ovary removed

No subsequent pregnancy	51	,,	Plac. præv.	39	3	,, (38 weeks)	,,	Lower segment	in. c.g., con. c.g.	Moderate	D.B.	Precautions
	52	,,	C.P.	27	1	Yes	,,	?	in. thr., con. c.g.	O	Alive and well	
	53	,,	,,	35	1	,,	,,	?	in. c.g., con. c.g.	Slight	D. 7 months	M. died March, 1919
	54	,,	,,	24	3	,,	,,	P	in. thr., con. c.g.	O	Alive and well	
	55	,,	,,	30	1	,,	,,	?	in. c.g., con. c.g.	Slight	,,	
	56	,,	,,	26	2	,,	,,	A	in. thr., con. c.g.	Moderate	,,	Precautions
	57	,,	,,	31	2	,,	,,	A	,, ,,	O	,,	
	58	,,	,,	28	3	,, (38 weeks)	,,	?	,, ,,	O	,,	
	59	,,	,,	26	1	Yes	,,	?	,, ,,	O	,,	No precautions
	60	,,	Eclampsia	29	1	No (36 weeks)	,,	?	in. c.g., con. c.g.	Slight	D. B. twins	
	61	,,	C.P.	32	8	Yes	,,	?	in. thr., con. c.g.	Moderate	Alive and well	
	62	,,	,,	30	1	,,	,,	?	,, ,,	O	,,	
	63	,,	,,	?	1	,,	,,	?	,, ,,	O	D.	
	64	,,	,,	40	7	,,	,,	?	,, ,,	O	Alive and well	
Delivery by natural passages (See also No. 71)	65	1914	C.P.	25	1	Yes	Median	?	in. c.g., con. c.g.	Slight	Twins 1 alive and well 2 D. 9 weeks	Normal labour, 1917 ,, 1920
	66	1915	,,	25	2	,,	,,	P	,, ,,	O	Alive and well	Normal delivery, 1918
	67	,,	Fibroma ovary	31	1	,,	,,	P	,, ,,	Moderate	,,	Normal labour, June, 1917
	68	,,	Eclampsia	31	1	,,	,,	?	in. thr., con. c.g.	Slight	D.B.	Labour at term, 1917, low forceps
	69	,,	C.P.	41	10	,,	,,	?	in. c.g., con. c.g.	O	D. 6 months	Normal labour at term, 1918
	70	1916	,,	23	2	,,	,,	P	,, ,,	O	Alive and well	Labour at term, 1920, forceps, 6 lb.
Repeated Cæsarean section	71	1912	C.P.	27	3	No	Median	P	in. c.g., con. c.g.	Slight	D. 14 days	2nd, 1913, term, not in labour; 5th preg., craniotomy 1915 : 3rd, term, 1916
	72	,,	,,	26	4	,,	,,	P	,, ,,	Severe	Alive and well	2nd, 1913, term, in labour
	73	,,	,,	19	1	,,	,,	?	,, ,,	O	,,	2nd, 1914, term, not in labour ; 3rd, 1917, term, not in labour (See also patients now pregnant.)
	74	,,	,,	30	1	Yes	,,	A	,, ,,	Slight	,,	2nd, 1920, 6 lb., term, not in labour
	75	,,	,,	20	1	,,	,,	?	,, ,,	Moderate	,,	2nd, 1915, term, not in labour ; 3 months' miscarriage, 1920

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	rexia	Infant	Remarks
JESSOP HOSPITAL FOR WOMEN, SHEFFIELD (*continued*).	76	1912	C.P.	30	2	Yes	Median	A	in. c.g., con. c.g.	Slight	Alive and well	2nd, 1919, in labour, sterilized
	77	1914	Eclampsia	19	1	,,	,,	?	,, ,,	Severe	,,	2nd, Aug. 1915, in labour, term 3rd, March, 1918, in labour, term
	78	,,	C.P.	35	2	,,	,,	A	,, ,,	O	,,	2nd, Dec., 1917, not in labour, term
	79	,,	,,	35	2	No	,,	?	,, ,,	Slight	,,	2nd, Feb., 1917, in labour, term ; 3rd, Sept., 1919, in labour, term, sterilized
	80	,,	,,	41	10	Yes	,,	?	,, ,,	Moderate	,,	2nd, Nov., 1916, term, in labour, sterilized
	81	,,	,,	31	1	,,	,,	?	in. thr., con. c.g.	,,	,,	2nd, Nov., 1917, in labour, term
	82	,,	,,	28	2	,,	,,	?	in. c.g., con. c.g.	Slight	D. 6 weeks	2nd, March, 1919, in labour, term
Repeated Cæsarean section (See also Nos. 102, 104)	83	1915	,,	25	1	,,	,,	A	,, ,,	O	Alive and well	2nd, Aug., 1919, in labour, term
	84	,,	,,	28	3	,,	,,	?	,, ,,	Slight	,,	2nd, May, 1917, in labour, term
	85	,,	,,	26	1	,,	,,	A	,, ,,	,,	,,	2nd, Aug., 1919, in labour, term ; 3rd, April, 1920, in labour, term, sterilized
	86	,,	,,	36	1	,, (36 weeks)	,,	A	,, ,,	O	Twins	2nd, Feb., 1917, in labour, term
											Alive and well	3rd, Dec., 1918, in labour, term
	87	,,	,,	34	6	Yes	,,	A	,, ,,	O	,,	2nd, May, 1918, in labour, term, sterilized
	88	,,	,,	26	1	,,	,,	?	,, ,,	Slight	,,	2nd, Nov., 1919, not in labour
	89	,,	,,	32	6	,,	,,	A	,, ,,	Moderate	,,	2nd, May, 1919, in labour, term, sterilized
	90	1916	,,	26	7	,,	,,	A	,, ,,	Slight	,,	2nd, April, 1918, in labour, term
	91	,,	,,	34	6	,,	,,	P	in. thr., con. c.g.	O	,,	2nd, April, 1918, in labour, term, sterilized
	92	,,	,,	20	1	,,	,,	A	in. c.g., con. c.g.	Slight	,,	2nd, October, 1917, in labour, term
	93	,,	,,	22	3	,,	,,	P	,, ,,	O	,,	2nd, Jan., 1918, in labour, term

Repeated Cæsarean section	94	,,	,,	29	3	,,	,,	P	,,	,,	O	,,	In labour 38 weeks, 2nd C.S.
	95	,,	,,	30	1	,,	,,	P	,,	,,	Slight	,,	2nd, Dec., 1918, in labour, term
	96	1917	,,	36	5	,,	,,	?	,,	,,	,,	,,	2nd, June, 1918, in labour, term
	97	,,	,,	28	4	,,	,,	?	,,	,,	,,	,,	2nd, Feb., 1919, in labour, term, sterilized
	98	1918	Repeated D.B. children	37	14	,,	,,	?	,,	,,	O	,,	2nd, Sept., 1919, in labour, term
	71	1913	C.P.	28	4	No	,,	P	,,	,,	Slight	,,	3rd, term, 1916
	73	1914	,,	21	2	Yes	,,	?	,,	,,	,,	,,	3rd, 1917, term, not in labour; now pregnant
	77	1915	,,	20	2	,,	,,	A	,,	,,	O	,,	3rd, March, 1918, in labour, term
	79	1917	,,	37	3	,,	,,	A	,,	,,	O	,,	3rd, Sept., 1919, in labour, term, sterilized
	85	1918	,,	30	2	,,	,,	?	,,	,,	O	,,	3rd, April, 1920, in labour, term, sterilized
	86	1917	,,	38	2	,,	,,	A	,,	,,	O	,,	3rd, Dec., 1918, in labour, term
Abortions	99	1914	,,	30	6	,,	,,	A	,,	,,	Slight	,,	Early abortion, 1919
	100	1916	,,	26	1	,,	,,	P	in. thr., con. c.g.		,,	,,	,, 1917
Now pregnant (See also No. 73)	101	1916	,,	37	12	,,	,,	P	in. c.g., con. c.g.		O	,,	Pregnant July, 1919
Rupture of scar	102	1913	,,	24	1	,,	,,	A	,,	,,	Slight	,,	2nd C.S., March, 1915, not in labour ; 3rd C.S., July, 1916, in labour, term ; rupture of scar, July, 1917, 8 months ; rupture of scar, Jan., 1916
	103	1914	,,	26	1	,,	,,	A	,,	,,	Severe	,,	2nd C.S., May, 1916, in labour, term
	104	,,	,,	25	4	,,	,,	A	,,	,,	O	,,	Rupture of scar, Feb., 1919
	105	1915	,,	39	8	,,	,,	P	,,	,,	Moderate	D. 1 week	Rupture of scar, Feb., 1918, 8 months

LEEDS MATERNITY HOSPITAL	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	C.P.	33	4	Yes	Median	—	2 layers con. c.g.	Slight	Alive and well	Precautions
	2	1913	,,	18	1	,,	,,	—	,, ,,	,,	,,	Unmarried
	3	1914	,,	32	2	,,	,,	—	,, ,,	O	,,	
	4	,,	,,	21	1	No	,,	—	,, ,,	Slight	,,	,,
	5	,,	,,	36	1	Yes	,,	—	,, ,,	Very slight	,,	
	6	1915	,,	36	2	,,	,,	—	,, ,,		,,	
	7	,,	,,	23	3	,,	,,	—	,, ,,	Moderate	,,	
	8	,,	,,	27	2	,,	,,	—	,, ,,	O	,,	
	9	,,	,,	24	1	No	,,	—	,, ,,	O	,,	
	10	,,	,,	29	2	Yes	,,	—	,, ,,	O	,,	
	11	,,	,,	28	1	,,	,,	—	,, ,,	O	,,	
	12	,,	,,	29	5	,,	,,	—	,, ,,	O	,,	1st and 2nd labours normal,
						No	,,	—	,, ,,	O	,,	3rd and 4th perforations
	13	,,	,,	35	1	Yes	,,	—	,, ,,	O	,,	Unmarried
	14	1916	,,	33	3	,,	,,	—	,, ,,	O	,,	
	15	,,	,,	25	2	,,	,,	—	,, ,,	Slight	,,	
	16	,,	,,	22	2	No	,,	—	,, ,,	O	,,	
	17	1914	,,	30	2							
	18	1916	,,	31	1	Yes	,,	—	,, ,,	Slight	,,	
	19	,,	,,	42	2	,,	,,	—	,, ,,	O	,,	
	20	,,	,,	25	1	,,	,,	—	,, ,,	Slight	,,	
	21	,,	,,	38	7	,,	,,	—	,, ,,	,,	,,	
	22	1917	Plac. prævia	38	1	,,	,,	—	,, ,,	O	,,	
	23	,,	C.P.	21	2	No	,,	—	,, ,,	O	,,	
	24	,,	,,	21	1	Yes	,,	—	,, ,,	O	D. 1 year	
	25	,,	,,	29	2	No	,,	—	,, ,,	O	Alive and well	
	26	,,	,,	36	3	,,	,,	—	,, ,,	O	,,	
	27	,,	,,	28	1	Yes	,,	—	,, ,,	Slight	D.B.	
	28	1918	,,	31	1	,,	,,	—	,, ,,	,,	Alive and well	
	29	,,	,,	26	1	,,	,,	—	,, ,,	,,	,,	Unmarried
	30	,,	,,	23	1	,,	,,	—	,, ,,	,,	D. 9 days	,,
	31	,,	,,	26	1	,,	,,	—	,, ,,	O	Alive and well	
	32	,,	,,	27	1	,,	,,	—	,, ,,	Slight	,,	,,
	33	,,	,,	26	1	No	,,	—	,, ,,	O	,,	
	34	,,	,,	27	1	,,	,,	—	,, ,,	Moderate	,,	
	35	,,	,,	27	1	Yes	,,	—	,, ,,	O	,,	

Delivery by natural passages	36	1916	Œdema of vulva	23	1	,,	,,	—	,,	,,	O	,,	Afterwards 1 normal delivery, term, D.B. and 2 abortions; after first baby patient became infected with syphilis
	37	1918	C.P.	23	1	,,	,,	—	,,	,,	Slight	D.B.	2nd delivery 1919, normal; baby alive and well
Repeated Cæsarean section	38	1912	,,	24	1	,,	,,	—	,,	,,	O	Alive and well	2nd, 1918; no complications
	39	1913	,,	20	1	,,	,,	—	,,	,,	O	,,	2nd, 1914; 3rd, 1916; sterilized
	40	,,	,,	28	4	,,	,,	—	,,	,,	Slight	,,	1st delivery forceps, D.B. 2nd, 3rd and 4th; sterilized
	41	1914	,,	30	3	,,	,,	—	,,	,,	,,	,,	2nd, 1919; no complications
	42	1915	,,	24	2	,,	,,	—	,,	,,	O	,,	
	43	,,	,,	21	1	15 hours	,,	—	,,	,,	O	,,	2nd, 1917; not in labour; 3rd, 1920; no complications
	44	,,	,,	28	6	No	,,	—	,,	,,	O	,,	2nd, 1919: sterilized
	45	,,	,,	32	2	Yes	,,	—	,,	,,	Slight	,,	1st, 1913
	46	,,	,,	36	3	No	,,	—	,,	,,	,,	,,	2nd, 1916; no complications
	47	1916	,,	30	4	Yes	,,	—	,,	,,	,,	,,	2nd, 1917
	48	,,	,,	38	8	,,	,,	—	,,	,,	O	,,	2nd, 1917
	49	,,	,,	29	2	,,	,,	—	,,	,,	Slight	D.B.	2nd, 1918
	50	,,	,,	40	6	,,	,,	—	,,	,,	O	Alive and well	2nd, 1919; no complications
	51	,,	,,	23	1	,,	,,	—	,,	,,	O	,,	2nd, 1918; 3rd, 1920; sterilized
	52	,,	,,	40	12	No	,,	—	,,	,,	O	,,	
	53	,,	,,	33	4	,,	,,	—	,,	,,	O	,,	1st and 2nd, craniotomy; 3rd, C.S.
	54	,,	,,	28	4	Yes	,,	—	,,	,,	Slight	,,	2nd, 1920
	55	,,	,,	38	12	,,	,,	—	,,	,,	O	,,	2nd, 1918; sterilized
	56	1917	,,	30	2	,,	,,	—	,,	,,	O	D. 17 hours	2nd, 1918
	57	,,	,,	24	1	,,	,,	—	,,	,,	Slight	D. 4 months	2nd, 1919
	58	,,	,,	36	4	No	,,	—	,,	,,	O	Alive and well	2nd, 1918
	59	,,	,,	35	3	,,	,,	—	,,	,,	O	,,	2nd, 1918; no complications
	60	,,	,,	22	1	,,	,,	—	,,	,,	O	D. 3 months	2nd, 1918
	61	,,	,,	27	1	,,	,,	—	,,	,,	O	Alive and well	2nd, 1919; no complications
	62	1918	,,	34	5	Yes	,,	—	,,	,,	O	,,	2nd, 1918
Rupture of scar	63	1914	,,	22	1	,,	,,	—	,,	,,	O	,,	2nd C.S., 1919, on opening abdomen uterine scar found to be open; placenta on anterior wall of uterus and bulging through open wound; patient and child normal

LONDON HOSPITAL

No subsequent pregnancy

No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
1	1912	C.P.	28	1	Yes	Median	?	2 layers catgut	Moderate	Alive and well	Died in December, 1918; influenza
2	1913	,,	39	2	No	,,	P.	2 layers in. c g.	O	,,	No precautions
3	,,	,,	40	3	Yes	,,	?	,,	Slight	,,	,,
4	,,	,,	30	6	,,	,,	P.	2 layers con. c.g	Severe	,,	,,
5	1914	,,	31	5	,,	,,	P.	1 layer deep in. c.g., con. c.g.	Moderate	,,	,,
6	,,	,,	45	?	No	,,	P.	2 layers catgut	O	,,	,,
7	,,	Eclampsia	36	1	,, (36 weeks)	,,	?	1 layer in. c.g.	Slight	,,	,,
8	,,	C.P.	39	4	Yes	,,	P.	2 layers catgut	O	,,	Husband in Army during war
9	,,	,,	33	2	,,	,,	?	1 layer in. s.w.g., con. catgut	Moderate	,,	
10	1915	,,	26	2	No	,,	P.	1 layer in. silk	O	,,	Precautions
11	,,	,,	39	5	Yes	,,	?	2 layers catgut	Severe	,,	Hysterectomy 1917; husband away since C.S.
12	1916	,,	30	6	No	,,	?	1 layer in. silk, con. catgut	Moderate	,,	Precautions
13	,,	Eclampsia	20	1	,, (36 weeks)	,,	?	,,	Slight	D.B.	No precautions
14	,,	C.P.	21	1	Yes	,,	?	,,	Severe	Alive and well	
15	,,	,,	27	?	No	,,	?	,,	Slight	,,	
16	,,	,,	26	2	Yes	,,	?	silk	O	,,	
17	,,	Eclampsia	29	1	No	,,	?	1 layer in. silk, con. catgut	O	,,	Precautions
18	,,	C.P.	23	1	?	,,	A.	2 layers catgut	O	,,	Husband away since C.S.
19	,,	,,	38	1	Yes	,,	?	1 layer in. silk, con. catgut	Moderate	,,	
20	1917	,,	40	7	,,	,,	?	,,	O	,,	Precautions
21	,,	,,	28	2	No	,,	?	2 layers silk	O	,,	,,
22	,,	,,	30	1	Yes	,,	?	1 layer in. silk, con. catgut	O	,,	,,
23	,,	,,	33	7	No	,,	?	,,	O	,,	
24	,,	,,	31	2	,,	,,	P.	1 layer in. s.w.g., con. catgut	Slight	,,	Precautions
25	,,	Large goitre	36	4	,,	,,	?	1 layer in. silk, con. catgut	Severe	D. 6 months	No precautions; husband away till May, 1919
26	,,	C.P.	30	5	Yes	,,	A.	,,	Severe	Alive and well	

No subsequent pregnancy	27	,,	Eclampsia	25	1	No (38 weeks)	,,	?	,,	O	,,	
	28	1918	Mitral stenosis	22	1	Yes	,,	P.	,,	O	,,	Precautions
	29	1915	C.P.	25	1	,,	,,	A.	2 layers catgut	Slight	,,	,,
Delivery by natural passages	30	1912	C.P.	20	1	Yes	Median	?	2 layers s.w.g.	O	,,	Induction premature labour 39 weeks ; easy (forceps), 5¼ lb. child ; no complications, 1914
	31	1914	,,	37	8	,,	,,	?	2 layers in. c.g.	O	,,	Induction premature labour 37 weeks ; fœtus born dead ; no complications, 1915
	32	,,	Eclampsia	32	3	No	,,	?	,,	Slight	,,	Induction premature labour 38 weeks, 1917 ; child alive ; no complications ; pregnant again now
	33	1916	C.P.	29	5	No	,,	?	1 layer in. silk con. catgut	Moderate	D. 1 day	Cephalotripsy, 1919, after long labour at term
	34*	1914	?	29	4	Yes	,,	?	2 layers catgut	Severe	,,	Labour at term, 1916 ; forceps delivery ; 7th child ; mild puerperal sepsis. This patient got a ruptured scar in 1919 ; see also under group "Rupture of Scar"
Repeated Cæsarean section	35	1912	C.P.	40	1	Yes	,,	?	2 layers catgut	Slight	D.B.	2nd, 1914 ; at term ; sterilized
	36	,,	Pelvic tumour	29	2	?	,,	A.	3 layers s.w.g.	O	Alive and well	2nd, 1917 ; at term ; sterilized 2½ months' abortion, 1915
	37	,,	C.P.	30	2	Yes	,,	?	2 layers catgut	Slight	,,	2nd, 1914 ; at term ; not in labour ; sterilized
	38	,,	,,	32	10		,,	?	,,	O	,,	2nd, 1913 ; at term ; not in labour
	39	1913	,,	33	2	Yes	,,	?	1 layer in. s.w.g.	O	,,	2nd, 1916 ; at term ; not in labour ; sterilized
	40	,,	,,	31	11	Yes	,,	?	2 layers catgut	O	,,	2nd, 1915 ; at term ; not in labour ; sterilized
	41	1914	,,	31	4	No	,,	P.	1 layer in. catgut	Slight	,,	2nd, 1917 ; at term ; not in labour ; pregnant again now

London Hospital (*contd.*)	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Repeated Cæsarean section	42	1914	C.P.	34	?	Yes	Median	P.	2 layers catgut	Moderate	Alive and well	2nd, 1916; at term; sterilized
	43	1915	,,	27	2	,,	,,	A.	,,	O	,,	2nd, 1917; at term; in labour twins
	44	,,	,,	20	1	No	,,	P.	,,	Moderate	,,	2nd, 1917; at term; in labour
	45	,,	,,	28	1	Yes	,,	?	,,	Slight	D.B.	2nd, 1916; at term; in labour
	46	,,	,,	24	1	No	,,	?	1 layer in. silk, con. catgut	O	Alive and well	2nd, 1920; at term; not in labour
Abortions	47	1915	C.P. (See also Case No. 36)	25	2	Yes	,,	?	Interrupted silk	O	Alive and well	Early abortion 1919; precautions
Now pregnant	48	1916	Eclampsia (See also Case No. 32)	19	1	No (38 weeks)	,,	?	1 layer in silk con. c.g.	Slight	Alive and well	Became pregnant, July, 1919
Rupture of scar	49	1914	C.P.	28	1	Yes	,,	A	2 layers c.g.	O	Alive and well	Rupture of scar, 1915
	50	,,	,,	27	3	,, (36 weeks)	,,	?	,,	Moderate	,,	Rupture of scar, 1916
	51	,,	Eclampsia	19	1	No (38 weeks)	,,	?	,,	Severe	D.B.	Rupture of scar, 1916; died
	34*	,,	C.P.	29	4	Yes	,,	?	,,	Severe	Alive and well	Rupture of scar, 1919. Had an intervening delivery by natural passages, 1916
	52	1917	Eclampsia	20	1	No (38 weeks)	,,	?	1 layer in. silk sup. con. c.g.	Moderate	D.B.	Premature labour 38 weeks, 1920; manual removal of placenta; sepsis; death; rupture of scar

St. Bartholomew's Hospital	1	1914	C.P.	31	4	Yes	Median	A.	in. s.w.g,, c.g.	O	Alive and well	
	2	1915	,,	29	4	,,	,,	P.	in. s.w.g.	Slight	,,	Precautions
	3	,,	,,	19	1	,,	,,	P.	,, ,,	O	,,	Husband away till 19 months ago
No subsequent pregnancy	4	1916	,,	21	1	,,	,,	P.	in. s.w.g., c.g.	O	,,	
	5	,,	,,	37	3	,,	,,	?	?	?	?	Precautions
	6	1918	Eclampsia	26	3	No (30 weeks)	,,	A.	in. s.w.g., c g.	O	?	
	7	,,	C.P.	23	1	No	,,	?	,, ,,	Moderate	Alive and well	Husband deserted her whilst in hospital
	8	,,	,,	24	1	Yes	,,	A.	,, ,,	?	,,	Single woman
	9	1919	,,	42	3	No	,,	?	,, ,,	?	D.	
	10	,,	,,	34	1	?	,,	A.	,, ,,	Slight	Alive and well	
Delivery by natural passages	11	1914	,,	26	1	Yes	,,	P.	s.w.g., c.g.	O	Alive and well	Two subsequent labours, 1916 and 1918; both children alive and well
	12	,,	,,	25	1	No	,,	P.	s.w.g.	O	A.	One subsequent labour, 1920, alive and well
	13	1915	,,	?	?	Yes	,,	?	s.w.g., c.g.	O	Alive and well	Induction 1918, baby alive and well
	14	1916	,,	24	2	,, (38 weeks)	,,	?	,, ,,	Slight	D. in 6 days	One subsequent labour, 1918, alive and wel
Repeated Cæsarean section	15	1913	,,	38	1	Yes (38 weeks)	,,	A.	in. s.w.g.	O	Alive and well	1st, 1912; 3rd, 1915
	16	1914	,,	38	5	?	?	?	?	?	D.	2nd
	17	,,	,,	35	1	Yes	Median	P.	in. s.w.g., c.g.	O	Alive and well	2nd, 1916; 3rd, 1918
	18	,,	,,	24	?	,,	,,	P.	,, ,,	Slight	D. cong. syph.	2nd, 1920, baby alive and well
	19	1915	,,	23	1	,,	,,	?	,, ,,	O	Alive and well	2nd, 1916; 3rd, 1917
	20	1916	,,	30	2	,,	,,	?	,, ,,	O	,,	2nd, 1918
	21	1917	,,	26	1	,, (37 weeks)	,,	?	?	O	,,	2nd, 1918
	22	1914	,,	23	2	Yes	,,	?	in. s.w.g., c.g.	O	,,	Two months pregnant now

GUY'S HOSPITAL	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	Fibroids	29	1	Yes	Median	P.	In. c.g. and con. c.g.	Moderate	Alive and well	Precautions
	2	1913	C.P.	36	5	No	,,	A.	,,	O	,,	Husband on Service, 1915-19
	3	,,	,,	25	P.	Yes	,,	P.	,,	Slight	,,	Unmarried
	4	,,	,,	30	S.	,,	,,	?	,,	,,	,,	
	5	1914	,,	43	4	No	,,	?	,,	Moderate	,,	Menopause 6 months after C.S.
	6	1916	,,	39	3	,,	,,	A.	,,	Severe	,,	Peritonitis, laparotomy on 6th day, recovery
	7	,,	,,	29	1	Yes	,,	?	,,	Slight	D. 1 day	Precaution
	8	1913	,,	28	1	,,	,,	A.	,,	,,	,,	
	9	1916	,,	34	2	No	,,	,,	,,	,,	,,	Husband absent on service until 1919
	10	1917	,,	33	5	,,	,,	?	,,	O	,,	Precautions
	11	,,	,,	36	5	,,	,,	?	,,	Moderate	,,	
	12	,,	,,	28	1	,,	,,	?	,,	Slight	,,	Precautions
	13	1918	Fibroids	42	P.	,,	,,	?	,,	Moderate	,,	
	14	,,	C.P.	27	1	,,	,,	?	,,	O	,,	Precautions
	15	,,	,,	34	1	?	,,	A.	,,	O	,,	
	16	1918	Hydatid mole	34	P.	Yes (24 weeks)	,,	?	,,	O	D. B.	
	17	,,	C.P.	32	3	No	,,	?	,,	Slight	Alive and well	Precautions
	18	,,	C.P.	30	P.	,,	,,	?	,,	,,	,,	
Delivery by natural passages	19	1914	Eclampsia	38	P.	No (37 weeks)	Median	?	In. c.g. and con. c.g.	Slight	Alive and well	Full term labour, 1918; forceps after 26 hours; 8 lb. 4 oz.; alive and well
	20	1915	Œdema of vulva	22	P.	Yes	,,	A.	,,	Severe	,,	In 1917 induction; D.B. In 1918, full term labour (uncomplicated); alive and well; now pregnant
	21	1916	Eclampsia	23	P.	No (38 weeks)	,,	,,	,,	,,	D. 6 weeks	In 1918, normal labour at term
	22	1917	Hydramnios, & malpresentation	27	3	Yes	,,	,,	,,	,,	D.B.	Normal labour; term in 1919
	23	,,	Ovarian cyst	39	P.	,,	,,	P.	,,	O	Alive and well	In 1919 normal labour, term
	24	,,	,,	34	P.	No	,,	?	,,	,,	,,	,, ,,

Repeated Cæsarean section	25	1912	C.P.	22	P.	No	Median	P.	In. c.g. and con. c.g.	Slight	Alive and well	2nd, 1915; term, not in labour not sterilized
	26	,,	,,	21	P.	Yes	,,	,,	,,	,,	,,	2nd, 1914; term, not in labour sterilized
	27	,,	,,	28	2	,,	,,	?	,,	Severe	,,	2nd, 1914; term; in labour sterilized
	28	1912	,,	28	2	Yes	,,	P.	,,	,,	,,	2nd, 1915; term; not in labour, sterilized
	29	1913	,,	32	3	,,	,,	?	,,	O	,,	2nd, 1917; term; not in labour, sterilized
	30	,,	,,	25	2	,,	,,	?	,,	Slight	,,	2nd, 1916; term
	31	1914	,,	32	1	No	,,	?	,,	,,	,,	2nd, 1916; term; not in labour, not sterilized
	32	1915	,,	24	2	,,	,,	?	,,	,,	,,	2nd, 1917; term; sterilized
	33	,,	,,	34	3	,,	,,	A.	,,	,,	,,	2nd, 1917: term; not in labour, sterilized
	34	,,	,,	29	1	?	,,	?	,,	Severe	,,	2nd, 1917; term; not in labour, sterilized
	35	,,	,,	27	2	?	,,	P.	,,	Slight	,,	2nd, 1919; term; in labour, sterilized
	36	1916	,,	27	1	Yes	,,	P.	,,	O	,,	2nd, 1919; term; in labour, sterilized
	37	1917	,,	30	P.	?	,,	?	,,	O	,,	2nd, 1919; term; not in labour, sterilized
Abortion	38	1912	C.P.	33	1	Yes	Median	P.	In. c.g. and con. c.g.	O	Alive and well	Pregnancy, 1913; terminated at 3rd month by medical practitioner, 1918
	39	1915	,,	26	P.	,,	,,	?	,,	Severe	,,	
	40	1914	,,	28	1	No	,,	P.	,,	Slight	,,	Abortion, 1917, at 3 months; precautions
Now pregnant (See also No. 20)	41	1914	C.P.	25	2	No	Median	A.	In. e.g. and con. e.g.	O	Alive and well	Became pregnant, Sept., 1919
	42	1916	Acc. hæm.	32	6	,,	,,	?	,,	Severe	D.B.	Became pregnant, Nov.,1919
	43	1917	C.P.	24	3	,,	,,	?	,,	,,	Alive and well	Became pregnant, Nov., 1919
	44	1918	,,	19	P.	,,	,,	?	,,	O	D. 3 months	Became pregnant again, July, 1919
	45	,,	,,	31	1	Yes	,,	?	,,	Slight	Alive and well	Became pregnant again, Nov., 1919

MIDDLESEX HOSPITAL	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	Fibroids	33	1	No (12 weeks)	Median	?	Deep in. silk, sup. con. catgut	O	—	Myomectomy ; no precautions
	2	,,	C.P.	23	2	?	,,	A.	,,	O	Alive and well	No precautions
	3	1914	,,	32	2	?	,,	?	,,	O	D.	,,
	4	,,	Bicorn. uterus	22	1	No (24 weeks)	,,	?	,,	Slight	,,	,,
	5	1915	C.P.	28	1	Yes St. 2	,,	?	,,	,,	D.B.	Obstr. labour ; no precautions
	6	,,	,,	35	1	Late St. 2	,,	?	Deep mat. silk, sup. con. silk	O	Alive and well	Myomectomy ; no precautions
	7	1916	,,	31	1	St. 2	,,	?	Deep mat. c.g., sup. con. c.g.	O	,,	No precautions
	8	,,	,,	31	3	Yes (36 weeks)	,,	?	Deep mat. c.g., sup. con. c.g.	O	D. 5 hours	,,
	9	,,	Plac. prævia	31	?	Yes	,,	?	,,	O	D. 24 hours	,,
	10	1917	Trans.-pres.	31	?	Late St. 2	,,	?	,,	Severe	Alive and well	,,
	11	,,	C.P.	29	1	Yes	,,	?	,,	O	,,	Precautions
	12	,,	Eclampsia	37	?	?	,,	?	Deep mat. c.g., sup. con. c.g.	O	D.B.	Mother died ; cardiac, 1919
	13	,,	C.P.	21	1	No	,,	?	,,	O	Alive and well	No precautions
	14	,,	,,	37	1	,,	,,	?	,,	Slight	,,	,,
	15	1918	,,	19	1	No	,,	?	,,	O	,,	,,
	16	,,	,,	23	1	?	,,	?	,,	Slight	,,	,,
	17	,,	Fibroids	26	1	No (16 weeks)	,,	?	,,	O	,,	,,
	18	,,	,,	43	?	? (32 weeks)	,,	?	,,	O	D. 5 hours	,,
	19	,,	C.P.	21	1	No	,,	?	,,	O	Alive and well	,,
	20	,,	,,	24	3	No	,,	?	,,	O	,,	,,
	21	,,	Plac. prævia	?	?	Yes (32 weeks)	,,	?	,,	O	D.B.	,,
	22	,,	C.P.	20	1	No	,,	A.	,,	O	Alive and well	,,
Repeated Cæsarean section	23	1912	C.P.	24	2	?	Median	P.	Deep mat. silk, sup. con. silk	O	Alive and well	2nd, 1916 ; no scar seen, sterilized
	24	,,	,,	21	1	?	,,	P.	,,	O	,,	2nd, 1913 ; no scar seen ; sterilized
	25	1913	,,	24	1	No (28 weeks)	,,	A.	,,	O	D. 14 days	2nd, 1914, adhesions ; 3rd, 1919, adhesions, no scar seen

Repeated Cæsarean section	26	1915	,,	19	1	?	,,	?	,,	O	D.	2nd, 1917; 3rd, 1919; no scars seen; few adhesions
	27	,,	,,	28	1	Yes	,,	?	,,	O	Alive and well	2nd, 1917; 3rd, 1918; no sign of scar; adhesions in 3rd C.S.
	28	,,	,,	32	1	,,	,,	?	,,	O	,,	2nd, 1917; no scar seen
	29	1914	,,	32	2	,,	,,	?	,,	O	D. 24 hours	2nd, 1919; no scar seen
Delivery by natural passages	30	1914	C.P.	32	1	Yes	Median	?	?	Very severe	D.B.	Uterine and abdominal wound both suppurated, and patient nearly died: left with weak abdominal wall with much scarring; 2 years later had full term child and vertex forceps delivery; 1 year later ruptured uterus in labour. (See also under group "Rupture of scar")
	31	1916	Fœtal death	41	1	No (24 weeks)	,,	?	Deep mat. c.g., sup. con. c.g.	O	,,	Had two confinements 11 months, and 2 years later, both full term normal labours
	32	1917	Plac. prævia	26	1	Yes (35 weeks)	,,	?	,,	O	Alive and well	Normal labour 2½ years later; child born easily, face, pains strong, labour short
Abortion	33	1914	Bicorn. uterus	22	1	No (24 weeks)	Median	?	Deep mat. silk, sup. con. silk	Slight	D.B.	One early miscarriage, 1919
	34	1917	C.P.	20	1	Yes	,,	A.	Deep mat. c.g., sup. con. c.g.	O	Alive and well	Two miscarriages: 1918, 3½ months; 1919, 2 months
Now pregnant	35	1916	C.P.	23	?	Yes	Median	?	Deep mat. c.g., sup. con. c.g.	O	Alive and well	9 months pregnant
	36	1918	Prolapse	36	?	No (28 weeks)	,,	?	,,	Slight	D.B.	5 months pregnant

MIDDLESEX HOSPITAL (*continued.*)	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Rupture of scar	30	1915	C.P.	32	1	Late St. 2.	Median	?	?	Severe	D.B.	2nd C.S. for rupture of uterus in second stage of labour 2 years later; full term, forceps delivery intervened, though suppuration of uterine and abdominal wounds at 1st C.S. had proved almost fatal. The 2nd C.S. showed thin uterine wall at site of rupture; fœtus dead in peritoneal cavity. Uterus sutured and mother recovered with almost afebrile puerperium. No record of placental site
MR. FURNEAUX JORDAN	1	1914	C.P.	36	1	Yes	Median	—	1 deep con. c.g.	Slight	Alive and well	Precautions
	2	1915	,,	28	1	,,	,,	—	,, ,,	O	D. 3 hours	No precautions
	3	,,	,,	25	1	No	,,	—	,, ,,	O	Alive and well	,,
	4	1916	,,	35	1	Yes	,,	—	,, ,,	O	D. 11 days	No precautions, hopes for pregnancy
No subsequent pregnancy	5	,,	,,	30	1	,, 3 days	,,	—	,, ,,	Slight	D. 24 hours	No precautions, hopes for pregnancy
	6	,,	,,	35	1	No	,,	—	,, ,,	O	Alive and well	Husband has phthisis, occupies separate bedroom
	7	,,	,,	32	1	Yes	,,	—	,, ,,	O	,,	No precautions
	8	,,	,,	23	2	,,	,,	—	,, ,,	Slight	D. 2 hours	,,
	9	1917	,,	28	1	13 hours	,,	—	,, ,,	O	Alive and well	,,
	10	,,	,,	26	1	Yes	,,	—	,, ,,	Slight	D. 6 months	,,
	11	,,	,,	21	1	,,	,,	—	,, ,,	O	D. 3 months	,,
	12	,,	,,	26	1	,,	,,	—	,, ,,	Slight	Alive and well	,,
	13	,,	,,	23	1	,,	,,	—	,, ,,	O	,,	,,
	14	1918	,,	33	1	No	,,	—	,, ,,	O	Twins Alive and well	,,
	15	,,	,,	27	1	Yes (32 weeks)	,,	—	,, ,,	O	,,	No precautions, after induction outside hospital
	16	,,	,,	33	1	Yes	,,	—	,, ,,	Slight	,,	No precautions

No subsequent pregnancy	17	,,	,,	26	1	No	,,	—	,,	,,	O	,,	,,
	18	,,	,,	23	1	,,	,,	—	,,	,,	O	,,	,,
	19	,,	,,	39	1	Yes	,,	—	,,	,,	Slight	D.B.	,,
	20	,,	,,	30	1	,,	,,	—	,,	,,	,,	Alive and well	,,
	21	,,	,,	27	1	,,	,,	—	,,	,,	O	,,	,,
	22	,,	,,	24	1	,,	,,	—	,,	,,	O	,,	,,
	23	1919	,,	35	2	No	,,	—	,,	,,	O	,,	First baby born dead, difficult forceps; now a widow
	24	,,	Eclampsia	32	1	Yes	,,	—	,,	,,	Moderate	,,	No precautions
	25	,,	C.P.	25	3	,,	,,	—	,,	,,	O	,,	1st pregnancy twins, D.B.; 2nd, forceps, D.B.; no precautions
	26	,,	Plac. prævia	?	?	,, (32 weeks)	,,	—	,,	,,	O	,,	No precautions
	27	,,	C.P.	30	1	Yes	,,	—	,,	,,	O	,,	,,
	28	,,	Fibroid	35	1	No	,,	—	,,	,,	O	,,	Cæsarean followed by myomectomy; no precautions
	29	,,	C.P.	31	1	,,	,,	—	,,	,,	O	,,	No precautions
Repeated Cæsarean section	30	1915	,,	31	2	Yes	,,	—	,,	,,	O	,,	1st, D.B., difficult forceps; 2nd. 1917, (sterilized at 2nd operation)
	31	1916	,,	25	1	24 hours	,,	—	,,	,,	O	D. few hours	2nd, 1919, (sterilized at 2nd C.S.)
	32	,,	,,	30	4	No	,,	—	,,	,,	O	Alive and well	2nd, 1920
	33	1917	,,	34	6	Yes	,,	—	,,	,,	O	D.B.	Craniotomy outside hospital, but could not be delivered, 5 previous, D.B., forceps; 2nd, 1919
	31	,,	,,	28	2	24 hours	,,	—	,,	,,	O	Alive and well	1st, craniotomy; 2nd, 1919
	35	1914	,,	36	1	Yes	,,	—	,,	,,	O	,,	2nd, 1916, and 3rd, 1920
Pregnant now	36	1912	,,	27	1	,,	,,	—	,,	,,	O	,,	Due September, 1920
	37	1915	,,	35	2	No	,,	—	,,	,,	O	,,	Due May, 1920
	38	1917	,,	30	4	Yes	,,	—	,,	,,	Slight	,,	,,
	39	,,	,,	29	2	15 hours Yes	,,	—	,,	,,	O	,,	1st, craniotomy; now 8 months pregnant
	40	1918	,,	25	1	,,	,,	—	,,	,,	O	,,	2 months pregnant
	41	,,	,,	19	1	12 hours Yes	,,	—	,,	,,	O	,,	7 ,,
	42	1919	,,	19	1	,,	,,	—	,,	,,	O	,,	4 ,,
	43	,,	,,	36	1	,,	,,	—	,,	,,	O	,,	8 ,,

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
CITY OF LONDON MATERNITY HOSPITAL No subsequent pregnancy	1	1912	C.P.	35	4	No	Median	A.	1 layer deep in. silk, con. c.g.	O	Alive and well	Precautions
	2	,,	Fibroid	38	1	Yes	,,	A.	1 layer deep in. s.w.g.	O	D.B.	Separated from husband since August, 1914
	3	1913	Prol. 1st stage	33	1	,,	,,	?	,,	Severe	,,	—
	4	,,	C.P.	31	2	No	,,	P.	2 layers in. silk	Slight	D. 9 days	—
	5	,,	,,	39	3	Yes	,,	P.	1 layer deep in. s.w.g.	,,	Alive and well	No precautions
	6	,,	,,	36	3	,,	,,	?	2 layers silk	O	,,	—
	7	,,	,,	31	3	No	,,	P.	1 layer deep in. s.w.g., con. c.g.	Moderate	,,	—
	8	1916	Fibroid	22	1	Yes (36 weeks)	,,	P.	1 layer deep in. silk, con. c.g.	,,	,,	Myomectomy; husband killed, 1917
	9	,,	Prol. 1st stage	30	2	Yes	,,	A.	2 layers c g.	Slight	,,	—
	10	,,	C.P.	29	2	No	,,	P.	1 layer deep in. silk, con. c.g.	O	,,	Precautions
	11	,,	,,	27	2	Yes (37 weeks)	,,	A.	2 layers silk	Severe	,,	—
	12	,,	Eclampsia	38	1	No (28 weeks)	,,	P.	1 layer deep in. silk, con. c.g.	Slight	D.B.	—
	13	,,	,,	35	3	No (37 weeks)	,,	A.	2 layers silk, con. catgut	Severe	Alive and well	—
	14	1918	C.P.	39	3	No	,,	P.	1 layer deep in. silk, con. c.g.	O	,,	—
	15	,,	,,	30	1	Yes	,,	A.	,,	O	,,	—
	16	,,	Fibroid	45	1	No	,,	A.	,,	O	D. 3 days	Husband died 8 months after C.S.
	17	,,	C.P.	42	5	,,	,,	P.	1 layer deep in. silk	O	Alive and well	No precautions
	18	,,	,,	31	2	Yes	,,	A.	1 layer deep, 1 layer superfic. in. silk	O	,,	—
	19	,,	Eclampsia	22	1	No	,,	A.	1 layer deep in. silk, con. c.g.	Slight	,,	—
	20	,,	C.P.	29	2	,,	,,	A.	,,	O	,,	—

Delivery by natural passages	21	,,	Eclampsia	28	1	No (36 weeks)	,,	?	1 layer deep in. silk, con. c.g.	Slight	D.B.	Induction of premature labour at 30 weeks, 1919, severe albuminuria ; fœtus dead ; no complications
	22	1915	Conc. acc. haem.	28	4	No (38 weeks)	,,	?	,,	Severe	,,	Normal labour, 1917 ; child 9½ lb. ; no complications
	23	,,	Eclampsia	22	1	No (35 weeks)	,,	P.	2 layers c.g.	O	Alive and well	Normal labour, 1919 ; child 6¾ lb. ; no complications
	24	1916	Con. acc. haem.	33	4	No	,,	P.	1 layer deep in. silk, con. c.g.	O	,,	Normal labour, 1919 ; child 7¼ lb. ; no complications
	25	,,	Eclampsia	20	1	Yes (38 weeks)	,,	P.	,,	O	,,	Normal labour, 1919, at term ; no complications
Repeated Cæsarean section	26	1912	C.P.	32	2	Yes	,,	P.	2 layers deep in. silk	O	Alive and well	2nd C.S., 1915, at term ; not in labour, sterilized
	27	,,	,,	30	4	No	,,	P.	1 layer deep in. silk	O	,,	2nd C.S., 1916, not in labour at term ; sterilized
	28	1914	,,	25	1	Yes	,,	A.	,,	Slight	,,	2nd C.S., 1917, at term ; not in labour, pregnant again now
Abortion	29	1913	Plac. praevia	30	4	No	,,	?	1 layer deep in. silk, con. c.g.	Severe	D. 19 days	Early abortion, 1919
	30	,,	C.P.	27	5	Yes	,,	P.	,,	O	Alive and well	2½ months abortion, 1917, precautions
	31	1917	,,	39	1	,,	,,	?	,,	O	D.B.	2 months abortion, 1918
Now pregnant	32	1916	C.P.	38	1	Yes	,,	P.	1 layer deep in. silk, con. c.g.	Moderate	Alive and well	Pregnant in September, 1919

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Edinburgh Maternity Hospital No subsequent pregnancy	1	1912	C.P.	28	1	Yes	Median	A.	1 layer deep in., 1 con. silk	O	Alive and well	Precautions
	2	,,	,,	26	3	No	,,	P.	1 layer deep in., 1 con. c.g.	O	,,	,,
	3	,,	,,	28	1	Yes	,,	?	1 layer deep in., 1 con. linen	O	,,	,,
	4	,,	,,	30	2	,,	,,	P.	1 layer deep in., 1 con. c.g.	O	,,	,,
	5	,,	,,	31	1	No	,,	?	,,	O	,,	,,
	6	1913	,,	34	2	Yes	,,	A.	1 layer deep in., 1 con, linen	O	,,	1st, craniotomy; precautions
	7	,,	,,	30	1	No	,,	A.	1 layer deep in. silk, 1 con. c.g.	O	,,	Precautions
	8	,,	,,	38	1	,,	,,	?	1 layer deep in. linen, 1 con. c.g.	O	,,	,,
	9	1914	Fibroid	42	1	Yes	,,	?	1 layer deep in., 1 con. silk	O	,,	,,
	10	,,	Eclampsia, C.P.	40	2	No (33 weeks)	,,	?	1 layer deep in., 1 con. c.g.	Slight	D. 5 days	,,
	11	,,	C.P.	36	6	Yes	,,	P.	1 layer deep in., 1 con. silk	O	Alive and well	,,
	12	1915	,,	28	2	,,	,,	P.	1 layer deep in., 1 con. linen	O	,,	,,
	13	,,	,,	30	2	,,	,,	?	1 layer deep in., 1 con. silk	Slight	,,	,,
	14	,,	,,	29	1	,,	,,	A.	1 layer deep in., 1 con. e.g.	O	,,	,,
	15	,,	,,	40	1	,,	,,	P.	,,	O	,,	,,
	16	1916	,,	22	2	,,	,,	?	1 layer deep in., 1 con. linen	Slight	D.B.	,,
	17	,,	,,	35	2	,,	,,	A.	1 layer deep in., 1 con. silk	O	Alive and well	,,
	18	,,	,,	29	2	,,	,,	?	,,	Slight	,,	,,
	19	,,	,,	27	1	,,	,,	P.	1 layer deep in., 1 con. c.g.	O	D. 7 days	,,
	20	1917	Pelvic tumour	22	1	,,	,,	A.	1 layer deep in., 1 con. linen	O	Alive and well	,,
	21	,,	,,	43	1	No	,,	P.	1 layer deep in. silk, 1 con. c.g.	O	,,	,,

No subsequent pregnancy	22	1918	,,	41	2	Yes	,,	A.	1 layer deep in., 1 con. c.g.	O	,,	,,
	23	,,	Large child	32	4	,,	,,	A.	1 layer deep in., 1 con. linen	O	,,	2nd, craniotomy, 16 lb.; 3rd, craniotomy, 15 lb.; takes precautions
	24	,,	C.P.	29	6	No	,,	A.	,,	O	,,	Craniotomy for all; precautions
	25	,,	,,	31	1	Yes	,,	P.	1 layer deep in., 1 con. c.g.	O	,,	Precautions
	26	,,	,,	20	2	,,	,,	P.	1 layer deep in., 1 con. linen	Slight	,,	,,
	27	,,	,,	30	1	,,	,,	A.	1 layer deep in. silk, 1 con. c.g.	O	,,	,,
Delivery by natural passages	28	1917	C.P.	27	1	Yes	,,	P.	1 layer deep in., 1 con. c.g.	Slight	Alive and well	Induced labour, 8th month, 1920
Repeated Cæsarean section	29	1912	C.P.	28	3	No	,,	?	1 layer deep in., 1 con. silk	Slight	Alive and well	
	30	,,	,,	30	3	Yes	,,	P.	1 layer deep in., 1 con. c.g.	O	,,	Sterilized
	31	,,	,,	21	3	No (35 weeks)	,,	A.	,,	O	,,	,,
	32	,,	,,	20	2	No	,,	P.	,,	O	,,	
	33	1913	,,	22	2	Yes	,,	P.	1 layer deep in., 1 con. silk	Slight	,,	1st, craniotomy; 2nd, C.S. 1916; is now pregnant
	34	,,	,,	32	2	,,	,,	?	1 layer deep in., 1 con. linen	O	,,	1st, craniotomy; 2nd, C.S. 1916; died 1919
	35	1915	,,	27	1	No	,,	?	1 layer deep in. linen, 1 con. c.g.	O	,,	2nd C.S. 1918
	36	1916	,,	25	1	Yes	,,	A.	1 layer deep in., 1 con. linen	O	,,	,,
Now pregnant	35	1916	C.P.	33	1	No	,,	P.	1 layer deep in., 1 con. silk	O	Alive and well	Pregnant January, 1920; two Cæsarean sections
	37	1918	,,	30	2	Yes	,,	P.	1 layer deep in., 1 con. linen	O	,,	Pregnant Oct., 1919
	38	,,	,,	38	1	,,	,,	P.	,,	O	,,	Pregnant Nov., 1919

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
GENERAL LYING-IN HOSPITAL, LONDON No subsequent pregnancy	1	1912	C.P.	37	5	Yes	Median	A.	1 layer deep in. thread, 1 con. c.g.	O	Alive and well	
	2	,,	,,	27	2	No (38 weeks)	,,	P.	2 layers in. thread	Slight	,,	
	3	1913	,,	24	2	Yes	,,	A.	1 deep in. thread, 1 sup. thread	,,	,,	
	4	1914	Plac. prævia	39	4	No (38 weeks)	,,	?	1 deep in. c.g., 1 in. silk	Moderate	,,	No precautions
	5	,,	C.P.	36	1	Yes	,,	A.	1 deep in. c.g., 1 con. c.g.	Slight	,,	Precautions
	6	1915	,,	29	6	,,	,,	?	2 layers in. thread	,,	D. 2 months	,,
	7	,,	,,	30	4	,,	,,	P.	,,	Moderate	Alive and well	
	8	,,	,,	25	1	No	,,	?	1 deep in. thread, 1 con. c.g.	Slight	,,	,,
	9	1916	,,	27	1	Yes	,,	?	2 layers s.w.g.	,,	,,	Died 1917, pneumonia
	10	,,	,,	39	3	,,	,,	?	1 deep in. thread, 1 silk	,,	,,	Precautions
	11	,,	,,	31	3	?	,,	?	2 layers s.w.g.	,,	,,	No precautions
	12	,,	,,	27	2	Yes (38 weeks)	,,	A.	1 deep layer s.w.g., 1 con. c.g.	O	,,	Died 1919, influenza
	13	,,	,,	35	5	No (38 weeks)	,,	A.	,,	Slight	,,	No precautions
	14	,,	,,	22	1	Yes (38 weeks)	,,	A.	1 deep in. thread, 1 con. thread	,,	,,	Precautions
	15	,,	,,	42	12	?	,,	?	,,	,,	,,	
	16	1917	,,	35	2	Yes (38 weeks)	,,	?	1 deep in. s.w.g., 1 con. c.g.	,,	,,	Died a year later
	17	,,	,,	35	10	Yes	,,	?	1 deep in. silk, 1 con. c.g.	,,	,,	Precautions
	18	,,	,,	43	7	,,	,,	?	,,	?	?	
	19	,,	,,	28	3	?	,,	?	,,	Slight	Alive and well	
	20	1918	,,	25	3	?	,,	?	?	O	,,	Precautions

Repeated Cæsarian section	21	1912	,,	?	4	Yes	,,	?	1 deep in. thread, 1 con. c g.	Moderate	Alive and well	1919, sub-total Cæsarean hysterectomy (old stitch abscess in uterine wall); D. with pulmonary embolism during puerperium
	22	,,	,,	21	1	,,	,,	?	1 deep in. silk, 1 con. c.g.	Slight	D.B.	2nd C.S., 1915
	23	1913	,,	28	1	Yes (36 weeks)	,,	Ant.	1 deep in. s.w.g., 1 con. c.g.	Moderate	Alive and well	2nd C.S., 1917, sterilization
	24	1914	,,	30	2	Yes	,,	Ant.	1 deep in. c.g., 1 con. silk	Slight	,,	2nd C.S., 1917
	25	1916	,,	37	2	No	,,	Ant.	2 layers thread	,,	,,	2nd C.S., 1918; 3rd C.S., 1920, slight adhesions
	26	1918	,,	27	1	Yes	,,	?	Deep in. s.w.g.	,,	D. 14 days	2nd C.S., 1919
Now pregnant	27	1914	,,	29	2	No	,,	?	1 deep in. s.w.g., 1 con. c.g.	,,	Alive and well	20 weeks pregnant
	28	1918	,,	31	7	?	,,	?	Deep in. s.w.g.	,,	,,	10 weeks pregnant
St. Thomas's Hospital	1	1912	C.P.	27	2	No	Median	A.	2 layers silk	O	Alive and well	No precautions
	2	,,	,,	27	1	Yes	,,	P.	,,	O	D.B.	
	3	,,	,,	35	4	No (37 weeks)	,,	A.	,,	O	Died	Widow, 6 years
No subsequent pregnancy	4	1914	Eclampsia	36	1	Yes	,,	P.	2 layers catgut	Slight	Alive and well	No precautions
	5	,,	C.P.	34	5	,,	,,	P.	2 layers silk	O	,,	,,
	6	,,	,,	30	2	,,	,,	A.	2 layers catgut	Slight	,,	
	7	1915	,,	39	4	,,	,,	P.	,,	,,	,,	,,
	8	1916	Eclampsia	26	1	Yes (38 weeks)	,,	P.	,,	O	,,	Precautions
	9	,,	C.P.	41	3	Yes	,,	P.	,,	Slight	,,	,,
	10	1917	Eclampsia	25	1	No (38 weeks)	,,	P.	,,	O	,,	No precautions
	11	,,	C.P.	41	2	No	,,	P.	,,	O	,,	,,
	12	1918	,,	30	1	Yes	,,	A.	2 layers silk	O	,,	,,
	13	,,	,,	38	2	No	,,	P.	,,	O	,,	,,
	14	,,	,,	34	2	,,	,,	P.	2 layers catgut	O	,,	
	15	,,	,,	35	5	,,	,,	P.	,,	O	,,	,,
Delivery by natural passages	16	1915	Eclampsia	29	1	Yes	Median	A.	2 layers catgut	O	D.B.	3 normal labours since
	17	1916	Fibroids	31	1	No	,,	A.	,,	Slight	Alive and well	Cæsarean hysterectomy; normal labour, 1919

St. Thomas's Hospital (*continued*)	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
Repeated Cæsarean section	18	1912	C.P.	21	1	Yes (36 weeks)	Median	A.	2 layers silk	O	Alive and well	2nd, 1916, at term, in labour
	19	,,	,,	26	2	,,	,,	P.	,,	O	Died	2nd, 1914, at term, in labour
	20	1914	,,	23	2	,,	,,	A.	2 layers catgut	O	Alive and well	2nd, 1918, at term, not in labour
	21	1915	,,	33	6	,,	,,	P.	,,	Slight	,,	2nd, 1918, at term, not in labour
	22	,,	,,	27	3	No	,,	P.	,,	O	,,	2nd, 1917 ; 3rd, 1918, both at term, and in labour
	23	1916	,,	42	5	,,	,,	A.	,,	O	,,	2nd, 1918 ; at term, not in labour
Abortions	24	1912	Eclampsia	33	1	Yes (38 weeks)	Median	A.	2 layers silk	Slight	Alive and well	2 months, September, 1919
Now pregnant	25	1913	C.P.	30	2	Yes	Median	P.	2 layers catgut	O	Alive and well	Now 6 months pregnant
	26	1918	,,	24	1	,,	,,	P.	,,	O	,,	Now pregnant
Rupture of scar	27	1914	Eclampsia	26	1	Yes (34 weeks)	Median	A.	2 layers catgut	Slight	D.B.	Admitted April 3, 1915, having had sudden attack of abdominal pain ; in state of collapse; abdomen normally distended. Dullness in flanks. *Per vaginam* no signs of labour ; infusion 2 pints, but patient died. Post-mortem : Small perforation in situation of scar, placenta directly underneath ; abdominal cavity full of blood

LEEDS GENERAL HOSPITAL No subsequent pregnancy	1	1912	C.P.	33	3	Yes	Median	?	2 layer in catgut.	O	Alive and well	Precautions
	2	,,	,,	27	3	?	,,	?	,,	O	,,	,,
	3	,,	,,	23	1	Yes	,,	?	,,	O	,,	Patient is single
	4	1913	,,	33	1	,,	,,	?	,,	O	D. 1 week	No precautions
	5	,,	,,	23	2	?	,,	?	,,	Slight	Alive and well	Precautions
	6	1914	,,	32	2	?	,,	?	,,	O	,,	,,
	7	,,	,,	27	M	Yes	,,	?	,,	O	,,	,,
	8	,,	,,	39	11	,,	,,	?	,,	O	,,	No precautions
	9	,,	,,	25	2	No	,,	P.	,,	O	,,	Precautions
	10	1915	,,	42	1	Yes	,,	?	,,	O	,,	No precautions
	11	,,	,,	41	3	No	,,	?	,,	O	,,	Precautions
	12	,,	,,	33	1	Yes	,,	?	,,	O	,,	Patient is single
	13	1916	,,	25	1	?	,,	?	,,	O	,,	,,
	14	,,	,,	29	3	?	,,	?	,,	O	,,	Husband away since 1916
	15	,,	,,	32	3	?	,,	?	,,	O	,,	Precautions
	16	1917	,,	29	1	No	,,	?	,,	O	,,	,,
	17	,,	,,	30	6	Yes	,,	?	,,	O	D. 5 weeks	,,
	18	,,	,,	42	3	,,	,,	?	,,	O	Alive and well	,,
	19	1915	,,	22	3	No	,,	?	,,	O	,,	,,
	20	1912	,,	32	2	,,	,,	?	,,	O	,,	,,
	21	1914	,,	35	2	,,	,,	P.	,,	O	,,	,,
	22	1916	,,	35	3	,,	,,	?	,,	O	,,	,,
Delivery by natural passages	23	1912	C.P.	22	1	Yes	Median	?	2 layer in. catgut	O	Alive and well	3 natural labours and 1 miscarriage since C.S.
	24	1913	,,	36	4	No	,,	?	,,	O	,,	1 since, small child, long lab.
	25	1917	,,	38	3	,,	,,	?	,,	O	,,	C.S. 2½ years ago
Repeated Cæsarean section	26	1912	C.P.	28	2	Yes	Median	A.	2 layer in. catgut	O	Alive and well	2nd, 1916; precautions
	27	1913	,,	28	1	,, (8 months)	,,	?	,,	O	,,	2nd, 1915; sterilized
	28	,,	,,	23	2	No	,,	P.	,,	O	,,	2nd, 1916; sterilized
	29	,,	,,	28	4	No (8 months)	,,	?	,,	O	,,	2nd. 1915; sterilized

	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
LEEDS GENERAL HOSPITAL (*continued*) Repeated Cæsarean section	30	1913	C.P.	27	4	No	Median	?	2 layer in catgut	O	Alive and well	2nd, 1914 ; sterilized
	31	1914	,,	22	2	Yes	,,	?	,,	O	,,	2nd, 1915 ; sterilized
	32	,,	,,	37	2	,,	,,	A.	,,	Slight	D.	2nd, 1915 ; precautions
	33	1915	,,	34	2	No	,,	?	,,	O	Alive and well	1st, 1912 ; 2nd, 1915 ; 3rd, 1918 ; sterilized
	34	1918	,,	29	2	Yes	,,	?	,,	O	,,	C.S. 4 years before ; sterilized
	35	1914	,,	28	4	,,	,,	?	,,	O	,,	2nd, 1916 : sterilized
	36	1915	,,	23	2	,,	,,	A.	,,	O	,,	1st, at Leeds Maternity Hospital ; now pregnant again
Now pregnant	37	1912	C.P.	38	2	No	Median	?	2 layer in catgut	O	Alive and well	1st, forceps, D.B., ; 2nd, 1912 ; 4 months pregnant
	38	1917	,,	30	3	Yes	,,	A.	,,	O	,,	Expects September, 1920
ROTUNDA HOSPITAL, DUBLIN No subsequent pregnancy	1	1914	C.P.	31	5	No	Median	?	1 layer in. silk, con. c.g. for peri.	O	Alive and well	Husband died 1919
	2	,,	,,	29	6	Yes	,,	A	,, ,,	O	,,	
	3	1915	,,	30	3	,,	,,	?	,, ,,	Moderate	,,	
	4	,,	,,	30	1	,,	,,	?	,, ,,	O	D. 5 minutes	
	5	1916	,,	27	1	,,	,,	?	,, ,,	O	Alive and well	Unmarried
	6	,,	Fibroid	36	1	,,	,,	?	,, ,,	O	,,	Precautions
	7	,,	C.P.	36	3	,,	Extra peri.	?	,, ,,	O	D. 9 months	
	8	1917	,,	29	3	,,	,,	?	,, ,,	O	Alive and well	Husband killed 1918
	9	,,	,,	23	1	,,	,,	?	2 layers catgut	Moderate	D. 1 day	
	10	,,	Fibroid	38	2	,,	Median	?	1 layer in. silk, con. c.g. for peri.	O	D.B.	
	11	1918	,,	38	2	,,	,,	?	,, ,,	O	Alive and well	
	12	,,	C.P.	20	1	,,	,,	?	,, ,,	O	,,	Unmarried
	13	,,	,,	24	4	No	,,	?	,, ,,	O	,,	
	14	1919	,,	28	1	Yes	,,	?	,, ,,	O	,,	

Delivery by natural passages	15	1915	Hyperemesis	24	1	No (32 weeks)	Median	?	1 layer in. silk, con. c.g. for peri.	O	D. 2 days	1918, normal
	16	,,	Con. Ac. Hæm.	33	3	No	,,	?	,, ,,	O	D.B.	1920, 3 hours in labour, full term, alive
	17	,,	C.P.	23	1	,,	,,	?	,, ,,	O	Alive and well	1920, normal, 6 lb., alive
	18	,,	,,	18	1	Yes	,,	?	,, ,,	Moderate	,,	1919, forceps, 26 hours labour, alive
Repeated Cæsarean section	19	1912	C.P.	35	3	No	Median	A	1 layer in. silk, con. c.g. for peri.	O	Alive and well	2nd, 1915; takes precautions
	20	1913	,,	28	3	Yes	,,	?	,, ,,	O	,,	1915; 3rd, 1917; takes precautions
	21	1915	,,	28	3	,,	,,	?	1 layer in. silk	O	,,	1917; rupture of uterus 36th week, 5th pregnancy
	22	,,	,,	22	1	,,	,,	?	,, ,,	O	,,	1919
	23	1917	Fibroid	29	3	,,	,,	?	,, ,,	O	,,	2nd, 1917; followed by myomectomy
Now pregnant	24	1916	C.P.	23	1	Yes	Median	?	1 layer in. silk	Moderate	Alive and well	Pregnant from Nov., 1919
	25	1917	,,	23	1	,,	Extra peri.	?	2 layers catgut	,,	Died	Pregnant Oct., 1919
	26	,,	Con. Ac. Hæm.	39	9	No prem.	Median	?	2 con. c.g., 5 in. silk	O	D.B.	Pregnant 24 weeks, fœtus dead, toxæmia, hæmaturia at present
	27	1918	After Vent.-fix	29	6	Yes	,,	?	1 layer in. silk, con. c.g. for peri.	O	,,	Pregnant Dec., 1919
	28	1919	C.P.	27	1	,,	,,	?	,, ,,	O	D.B. 3 weeks	Pregnant Nov., 1919
Rupture of scar	21	1915	C.P.	28	3	Yes	Median	?	1 layer in. silk, con. c.g. for peri.	O	Alive and well	Scar ruptured 36th week, 1920, after short doubtful labour before coming into hospital, recovery
		1917			4	,,	,,	?	,, ,,	O	,,	

Mr. B. Whitehouse	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	C.P.	28	2	No	Median	P.	3 in. through and through c.g.; 1 deep con. c.g.; 1 sup. thread	O	Alive and well	Precautions
	2	,,	Renal disease	34	2	Yes	,,	P.	,,	O	,,	Died 1914, chronic nephritis
	3	1913	C.P.	29	3	No	,,	A.	,,	O	,,	No precautions
	4	,,	,,	24	1	Yes	,,	?	,,	O	,,	,,
	5	1914	Plac. prævia	37	4	Yes (36 weeks)	,,	?	,,	O	,,	Husband in army during war. No precautions
	6	1917	C.P.	39	4	No	,,	?	,,	O	,,	No precautions
	7	1918	Eclampsia	33	1	Yes	,,	P.	,,	O	D.B.	Husband died 1919
	8	,,	,,	30	1	,,	,,	A.	,,	Severe	,,	Takes precautions
	9	,,	Plac. prævia	40	5	,,	,,	?	,,	O	,,	No precautions
	10	,,	C.P.	27	1	,,	,,	P.	,,	O	,,	,,
	11	,,	,,	41	3	No	,,	P.	,,	Moderate	,,	,,
	12	,,	,,	32	2	Yes	,,	A.	,,	O	,,	Precautions
	13	,,	Plac. prævia	37	3	,, 36 weeks)	,,	?	,,	O	,,	No precautions
Repeated Cæsarean section	14	1912	C.P.	37	3	No	Median	P.	3 in. through and through c.g.; 1 deep con. c.g.; 1 sup. thread	O	Alive and well	2nd, 1916, at term
	15	1913	,,	36	2	,,	,,	P.	,,	O	,,	2nd, 1915, at term
	16	1914	,,	33	2	,,	,,	A.	,,	O	,,	2nd, 1916, at term
Abortion	17	1913	C.P.	28	2	Yes	Median	A.	3 in. through and through c.g.; 1 deep con. c.g.; 1 sup. thread	Moderate	Alive and well	Early abortion 1915 and 1917
	18	1914	Plac. praev.	34	3	,, (32 weeks)	,,	?	,,	O	D. 7 days	Early abortion 1918

Now pregnant	19	1914	C.P.	30	1	Yes	Median	A.	3 in. through and through c.g. ; 1 deep con. e g. ; 1 sup. thread	O	Alive and well	Now pregnant 6 months
	20	1916	,,	24	1	,,	,,	P.	,,	Moderate	,,	Now pregnant 4 months
St. George's Hospital No subsequent pregnancy	1	1912	C.P.	32	2	No	Median	A.	Deep and sup. s.w g.	Very slight	Alive and well	Precautions
	2	1913	,,	28	2	,, (8 months)	,,	P.	,,	O	,,	
	3	,,	Cardiac	30	1	No	,,	P.	,,	Slight	,,	
	4	1914	C.P.	28	2	,,	,,	P.	,,	Very slight	,,	Precautions
	5	,,	Eclampsia	33	3	Yes	,,	P.	,,	,,	D.B.	,,
	6	1915	C.P.	36	1	,,	,,	A.	Deep s.w.g. sup. c.g.	O	Alive and well	,,
	7	,,	,,	26	2	No (8 months)	,,	A.	,,	Very slight	D.	
	8	1916	Cardiac	33	2	,,	,,	P.	Deep and sup. s.w.g.	O	D.	Developed left sided hemiplegia
	9	,,	C.P.	33	4	Yes	,,	P.	,,	O	Alive and well	Patient lately died
	10	,,	Cardiac	34	1	,,	,,	P.	,,	O	,,	
	11	,,	C.P.	31	3	No	,,	A.	,,	O	,,	
	12	1917	,,	28	1	,,	,,	?	Deep s.w.g. sup. c.g.	Very slight	,,	
	13	1918	,,	28	2	,,	,,	A.	,,	Slight	,,	Precautions
Subsequent Cæsarean section	14	1915	C.P.	28	2	Yes	Median	A.	Deep s.w.g., sup.	Slight	D.B.	2nd, 1917, term, in labour, sterilized

Mr. C. Martin.	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1912	C.P. ovar. cyst	31	1	No	Median	?	2 layers silk, deep in. and sup.	O	Alive and well	
	2	1914	C.P.	41	4	,,	,,	?	,,	O	,,	
	3	1915	,,	36	1	Yes	,,	?	2 layers catgut (picric)	O	,,	
	4	,,	,,	16	1	Yes (8 months)	,,	?	,,	Moderate	,,	
	5	,,	Plac. prævia	29	3	Yes	,,	P.	,,	,,	,,	
	6	,,	C.P.	38	3	,,	,,	?	,,	,,	,,	
	7	,,	Plac. prævia	23	2	,,	,,	?	,,	,,	,,	
	8	1916	C.P.	20	1	,,	,,	?	,,	O	,,	
	9	1917	C.P. ovar. cyst	33	1	Yes (8 months)	,,	A.	,,	O	,,	
	10	,,	C.P.	36	5	Yes	,,	?	,,	O	,,	
	11	,,	,,	28	2	,,	,,	?	,,	Moderate	D.	
	12	,,	,,	38	1	,,	,,	?	,,	O	Alive and wel	
	13	1918	,,	25	3	No (8 months)	,,	?	,,	O	,,	
Repeated Cæsarean section	14	1915	C.P.	26	2	Yes	Median	?	2 layers silk	O	Alive and well	2nd, 13 months later
	15	1917	Cicatricial convex	52	2	Yes (8 months)	,,	?	2 layers catgut	O	,,	2nd, 1918

WESTMINSTER HOSPITAL	1	1912	C.P.	29	1	No	Median	?	1 layer deep in. silk, con. silk	Slight	Alive and well	
No subsequent pregnancy	2	1913	,,	26	1	,,	,,	?	,,	O	,,	
	3	1915	,,	34	2	,,	,,	?	,,	O	,,	
	4	1916	,,	31	1	,,	,,	?	,,	Moderate	,,	
	5	1915	,,	30	1	,,	,,	?	,,	O	,,	
	6	1916	,,	38	1	,,	,,	?	,,	O	,,	
	7	1917	Cardiac disease	20	1	,,	,,	?	,,	Moderate	,,	
	8	,,	C.P.	35	3	Yes	,,	?	,,	O	,,	
	9	,,	,,	31	1	No	,,	?	,,	Slight	,,	
Repeated Cæsarean section	10	1917	C.P.	23	1	No	,,	?	,,	O	,,	2nd, 1918; at term; not in labour
Pregnant now	11	1917	C.P.	28	1	No	,,	?	,,	O	,,	Pregnant again, July, 1919
DR. BETHEL SOLOMONS	1	1914	C.P.	33	1	Yes	Median	?	In. silk, con. c.g.	O	Alive and well	
No subsequent pregnancy	2	1915	,,	28	2	No	,,	?	,,	O	,,	1st, craniotomy
	3	1917	,,	28	1	,,	,,	?	,,	O	,,	
	4	1918	Pelvic sarcoma	27	1	,,	,,	?	,,	O	,,	Patient died 6 months after C.S.
Repeated Cæsarean section	5	1913	C.P.	25	2	No	Median	?	In. silk, con. c.g.	O	Alive and well	1st, craniotomy; 2nd, 1916

Dr. Darwall Smith	No.	Year	Indication	Age	Para	In labour	Incision	Placental site	Suture method	Pyrexia	Infant	Remarks
No subsequent pregnancy	1	1913	Eclampsia	32	1	No (36 weeks)	Median	A.	1 layer deep, int. s.w.g.	0	Alive and well	No precautions
	2	1914	Plac. prævia	28	3	No (35 weeks)	,,		,,	0	D. 3 days	Precautions
	3	,,	C.P.	28	1	Yes	,,	,,	,,	0	D. 3 years	No precautions
	4	1915	Sacral tumour	38	3	,,	,,	,,	,,	0	Alive and well	Mother died of splenic anæmia 3 years after C.S.
	5	1916	C.P.	31	2	No	,,	,,	,,	0	,,	Precautions
	6	,,	,,	41	1	Yes	,,	P.	,,	0	,,	,,
	7	,,	,,	35	1	Yes (38 weeks)	,,	,,	,,	0	,,	Abdominal myomectomy ; precautions
Women's Hospital, Birmingham No subsequent pregnancy	1	1913	C.P.	35	—	No	Median	?	2 layers con. c.g. deep and superficial	0	Alive and well	Precautions
	5	1918	,,	39	—	,,	,,	?	,,	0	,,	No precautions
Delivery by natural passages	2	1916	C.P.	37	—	No	Median	?	2 layers con. c.g. deep and superficial	0	Alive and well	1st labour, craniotomy ; 2nd, C.S. ; 3rd, 2 years later, natural delivery, living child
	6	1915	Plac. prævia	32	—	,,	,,	?	,,	0	,,	Normal labour ; living child 3 years later
Repeated Cæsarean section	3	1916	C.P.	28	—	No	Median	?	2 layers con. c.g. deep and superficial	0	Alive and well	2nd C.S., 1st in 1914 ; precautions
	4	1917	,,	26	—	,,	,,	?	,,	0	,,	2nd C.S., 1st in 1915 ; sterilized after second

Dr. J. M. Munro Kerr, M.D.

We are here to discuss one of the most interesting problems in obstetric surgery at the present time—i.e., the uterine cicatrix after conservative Cæsarean section.

I feel I am voicing the opinion of all enlightened obstetricians in this and other countries when I say that our desire is to perform the conservative operation and not to sterilize the patient. We feel that sterilization of the patient after Cæsarean section, unless there is some definite disease of uterus, heart, lungs, &c., or mental weakness, is a crude procedure and only justifiable if it is proved beyond doubt that it is not possible to secure a sound uterine cicatrix. If such a decision is forced upon us it will be most unfortunate, for it will undoubtedly compel us to limit the scope of Cæsarean section and preclude us from extending the operation to many obstetrical complications which we feel could be more suitably dealt with by Cæsarean section than by the ordinary methods at present employed. It is unnecessary to enter into details regarding such conditions. It would only take up time and divert us from the definite subject upon which we should concentrate our attention this afternoon.

The fact that we have given the subject of the uterine cicatrix the honour of a full-dress debate is an admission that we are not quite satisfied that by the methods we ordinarily employ at the present time we can secure a cicatrix which will stand the strain of a subsequent pregnancy and labour.

In this communication I propose to discuss the subject under the following heads:—

(1) The evidence that the uterine scar in conservative Cæsarean section is frequently unsatisfactory.

(2) The reasons why the uterine scar is so frequently defective.

(3) The means by which a better scar can be secured with the ordinary longitudinal incision.

(4) An alternative incision, which I consider preferable to the ordinary longitudinal incision, as I believe it will give a sounder cicatrix.

(I) THE EVIDENCE THAT THE UTERINE SCAR IN CONSERVATIVE CÆSAREAN SECTION IS FREQUENTLY UNSATISFACTORY.

We have just heard a most interesting and important contribution by Eardley Holland, which goes to prove that there is definite evidence that in a fair percentage of cases the uterine scar is not satisfactory. I do not propose to go into this aspect of the subject, but I should like to say a word about our experiences in Glasgow Maternity Hospital.

Unfortunately, owing to the peculiar arrangements regarding the medical staffing of the Royal Glasgow Maternity and Women's Hospital, the absence of any registrar, and the enormous amount of work put through, the records of cases of Cæsarean section as regards such details as time of operation, suture material, the method of stitching, &c., are not available. Dr. Shannon, with the assistance of Dr. Hewitt and Dr. Lindsay, have, however, gone into the matter very carefully. They have found that the total number of Cæsarean sections from 1912 to 1919 inclusive is 331, with a maternal mortality of eighteen, or 5·5 per cent. This figure is extremely satisfactory, considering the fact that it includes a large number of cases in which there was possible infection before the patients were admitted to hospital. A point of real importance and interest, however, is the fact that in only ninety-four cases was the patient left unsterilized. The reason for there being only ninety-four cases is that a number of the members of the staff prefer to sterilize a patient after the first Cæsarean section.

Report by Dr. Douglas M. Lindsay and Dr. J. Hewitt, Glasgow Maternity Hospital.

The Strength of the Cæsarean Section Scar in Subsequent Pregnancy and Labour.—In submitting the following observations on the above subject, we desire to acknowledge in the first place the courtesy of the medical staff of the Glasgow Royal Maternity Hospital, who have unreservedly placed the records of their cases at our disposal, and in the second place the readiness with which the Directors granted free access to the hospital registers. As our abstract shows, we have been able to trace the subsequent obstetric history of ninety-four patients. Of these, forty patients (42·6 per cent.) have not since become pregnant, fifty-four patients (57·4 per cent.) have become pregnant since operation, and eight patients (8·5 per cent.) have conceived for a second time since operation. We therefore have in these cases an opportunity of investigating the strength of the scar in 62 pregnancies. In seven instances the pregnancy was not sufficiently far advanced to produce an appreciable strain on the scar. These we therefore discount. Of the remaining fifty-five cases, two patients are at present bearing the strain of an eight months' gestation, thirty-nine were delivered by abdominal Cæsarean section after the onset of labour, and seven similarly delivered before labour had set in; three cases terminated by normal labour, one by a severe breech labour, one as a forceps delivery, and two as craniotomies. In this series of fifty-five scars we can record one rupture, but on two occasions the operator noted that the scar was dangerously thin; in one of these the surgeon expressed the opinion that rupture would inevitably have occurred had the patient been permitted to go into labour. We have to record, on the other hand, that frequent mention is made of the soundness of the scar. In our series of fifty-five scars subjected to the strain, we can record one which ruptured (1·8 per cent.), one on the point of rupture (1·8 per cent.), and one dangerously thin (1·8 per cent.). In all, therefore, danger existed in 5·5 per cent.

From our investigations we are forced to conclude:—

(*a*) That there is a relative sterility following Cæsarean section to the extent of 42·6 per cent.

(*b*) That abortion is relatively uncommon, only occurring in 5·3 per cent.

(*c*) That the liability to rupture is present in 5·5 per cent.

(*d*) That rupture occurs in 1·8 per cent.

There is, however, no record of the exact number of cases in which the uterine scar was weak. Personally, I can remember a considerable number of cases in which I observed thinning of the scar, and indeed in the last case I operated upon a few week ago, although the scar looked sound on the surface I found that after I had removed the child and examined the scar it was very much thinner than the rest of the uterine wall. I draw special attention to this fact, for I think it is sometimes overlooked.

In recent years practically all writers on the subject have come to the conclusion that the uterine scar is frequently unsatisfactory. Take for example the most important contribution made by Couvelaire. This author, in his most excellent work, "Introduction à la Chirurgie Utérine Obstétricale," states on p. 141 that in 17 per cent. of cases there is an unsatisfactory cicatrix, in 10 per cent. extreme thinning of the cicatrix and in 2 per cent. rupture of the uterus.

We have, therefore, definite evidence that the uterine scar after conservative Cæsarean section is not as sound as is generally supposed, that it frequently gives way completely or partially, and that in a very considerable number of cases it is thinned, and would easily give way if any special strain were thrown upon it.

(II) THE REASONS WHY THE UTERINE SCAR IS SO FREQUENTLY DEFECTIVE.

For many years I have been particularly interested in this aspect of the subject, and have incidentally referred to it on several occasions when writing on Cæsarean section.[1]

If you were to ask a general surgeon why the Cæsarean section wound is unsatisfactory in a number of cases, he would almost certainly give the answer that it was due to faulty technique, for he would have in his mind the excisions and repairs he is accustomed to make in the abdominal cavity and elsewhere. As a matter of fact, I have tested one or two surgeons on the point and have received the answer expected. I beg, however, to differ from them, and to offer the opinion that the process of healing in the uterine wound is liable to certain disturbing influences which do not prevail in wounds elsewhere.

The first of these is the difficulty in securing complete asepsis. Now this is specially difficult to secure in the uterine wound, because of the double danger of infection from the abdominal wound and from the vagina. Of course if the uterine wound becomes directly infected through the abdominal opening the "surgical team" is blamed, but owing to the fact that Cæsarean section has often to be performed in a hurry, with the patient imperfectly prepared, and upon a structure so easily infected, it is not to be wondered at that even in the hands of the most careful and experienced operators infection of the uterus from above cannot always be prevented. As regards infection from below, this is much more difficult to prevent, especially in cases previously examined and interfered with vaginally.

Probably infection is here, as in all wounds, the most important factor which militates against perfect union. In a considerable number of cases in which rupture has occurred there is a record of a febrile puerperium after the previous Cæsarean section, but in some cases in which I have observed thinning of the scar the recovery on the former occasion was absolutely afebrile. Of course this does not necessarily imply that there was no infection, for you may get a mild infection of a wound sufficient to interfere with perfect union without any fever or appreciable local or general disturbance.

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[1] "Operative Midwifery," 3rd ed., p. 440; "New System of Gynæcology," iii, p. 527.

Another very important factor which militates against an absolutely normal healing in the uterine wound is the fact that the uterine muscle fibres during the puerperium are in a state of degeneration. An autolysis occurs in the muscle-fibres. It stands to reason, therefore, that the healing process must be interfered with in the early days of the puerperium as a result of this degeneration. I should like to draw special attention to this factor, for although it is impossible to estimate its importance I cannot but think that it must be very considerable.

A third disturbing influence is the fact that the sheets of muscle which form the uterine wall are irregularly distributed. This is seen very distinctly whenever the uterus begins to retract after the child has been extracted. The surface of the wound instead of being smooth becomes irregular and puckered, and no matter how careful the surgeon is he will find it difficult to prevent the occurrence of small pockets and collections of blood when he brings the surfaces of the wound together.

A fourth disturbing factor is the state of unrest of the uterus subsequent to operation. Not only does the uterus "retract," but from time to time it "contracts." If the uterus contracts before the sutures are inserted you will observe that the edges and surfaces gape, and if you watch a stitched uterine wound you will see that the stitches are strained when the uterus contracts. This alternate contraction and relaxation of the uterus, therefore, disturbs exact coaptation between the two surfaces, and so favours the occurrence of small collections of blood between them.

A fifth and very important factor is the necessity imposed upon the surgeon to employ his ligatures not only as a coaptor but as a hæmostatic agent. For the ideal healing of a wound, next to asepsis comes complete hæmostasis. The general surgeon secures this by picking up bleeding vessels and if necessary applying ligatures to them. The obstetric surgeon cannot do this. He has to apply his sutures firmly if he wishes to stop bleeding and prevent the effusion of a certain amount of blood between the cut surfaces of the uterine wound. I shall refer to this matter later under (III).

There is yet another disturbing factor. If the placenta is situated on the anterior wall, and this, as I have shown elsewhere,[1] occurs in 40 per cent. of cases, the operator will find that he has a layer of tissue peculiarly difficult to stitch and coapt exactly. It is very spongy, very friable, and contains large vessels, and no matter how carefully he applies his sutures blood collects between the edges with the result that there is a tendency for a gutter to form along the internal part of the wound. Into this gutter at the subsequent pregnancy the membranes protrude and a hernia gradually develops, and this is the ordinary method of rupture.

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[1] "Operative Midwifery," 3rd ed., p. 425.

I maintain, therefore, that there are very decided factors peculiar to the uterine wound which militate against an absolutely sound uterine cicatrix.

(III) THE MEANS BY WHICH A BETTER SCAR CAN BE SECURED WITH THE ORDINARY LONGITUDINAL INCISION.

The first detail is the prevention of infection. Undoubtedly it would be of tremendous advantage if we could always have patients resident in hospital and carefully prepared some time beforehand. Now that ante-natal cliniques have been established and the prospective mother is being looked after, matters will improve and patients requiring Cæsarean section will not be so frequently rushed into hospital or nursing home at the last minute, and so the preparations for operation will be leisurely and thoroughly carried out.

Some years ago I advocated the delivery of the placenta by the vagina after Cæsarean section, especially in cases where there was a possible infection of the vagina. I am convinced that the uterine wound is frequently infected by manual removal of the placenta, and especially by dragging the lowermost part of the membranes up through it. Naturally the procedure of forcing the placenta downwards into the vagina, as occurs in normal labour, can only be employed when the cervix is well dilated, and this raises the question of the time when Cæsarean section should be performed.

In Cæsarean section performed for pelvic deformity, the commonest indication for Cæsarean section, the ideal time to operate is when the os is fairly well dilated. But where the obstruction is from fibroid tumours, and where hysterectomy is probably necessary, it is better to operate in the last few days of the pregnancy before labour has started, for then the cervix is undilated and the stump of the cervix or vagina can be more easily stitched over. In cases in which the operation has to be performed for grave complications of pregnancy, such as eclampsia, one has naturally no choice as regards time; one must deal with the condition whenever it is thought necessary to empty the uterus by this procedure.

Another important matter is the manner of stitching the wound. There is some diversity of opinion as to whether the uterine wound should be stitched in layers or with through-and-through sutures. The general feeling at the present time seems to be that it is better to stitch in layers, and this is the procedure I have been following for some years.

Very important also is the material used for suturing. For many years I used nothing but catgut, and I am inclined to think that in some of my cases where there was a weak cicatrix the suture material was to blame, not because of the danger of sepsis (with carefully prepared catgut that danger can be excluded nowadays), but because the catgut yields too much and does not keep the surfaces of the uterus so exactly coapted as silk does. In recent years I have been stitching the under layer with catgut, but the bulk of the muscle tissue with linen thread or fine silk, and the superficial peritoneal surface with a continuous suture of fine catgut.

Another very important detail is to suture the uterus while it is in a state of "retraction" as distinguished from that of "contraction." Now one usually gets ten minutes or a quarter of an hour after the child is delivered when there is comparatively little placental separation, and very frequently only slight uterine contraction. With the uterus in this passive state one can stitch it more easily and coapt the surfaces more accurately. This is a very strong argument in favour of leaving the placenta to separate naturally and be expelled *per vaginam*, where this is possible. But even if the placenta is removed through the wound it is a great mistake to manipulate the uterus manually, or to give, as some operators do, an intramuscular injection of ergotin or pituitary extract. If the uterine wound bleeds too freely this can be controlled by temporary clamping the uterine and ovarian vessels, or by the assistant grasping the broad ligaments.

Another detail of some importance—it was brought to my notice by Dr. Martin, of the Glasgow Maternity Hospital—is the placing of the patient in the reclining or even sitting up position. This favours drainage.

(IV) AN ALTERNATIVE INCISION WHICH IN THE WRITER'S OPINION IS PREFERABLE TO THE ORDINARY LONGITUDINAL INCISION AS HE BELIEVES IT WILL GIVE A SOUNDER CICATRIX.

The extraperitoneal incision has been recommended in recent years by a number of authors, and the subject has been discussed in this Section of the Royal Society of Medicine on more than one occasion. But it never secured many adherents, largely because it is a more complicated operation and has never shown a lower mortality than the ordinary longitudinal incision. With most of what has been said against this extraperitoneal section I am in agreement. I have never been convinced that the advantages claimed for it have outweighed the many disadvantages and difficulties. It is therefore on other grounds and for other reasons that I ask you to consider an incision in the lower uterine segment in connexion with the subject we are discussing this afternoon.

During the last few years I have become more and more convinced that the lower uterine segment is an area peculiarly suitable for an incision whose cicatrix is likely to stand a subsequent pregnancy. I have therefore experimented on this incision and employed it on eighteen occasions. Before discussing its value let me describe briefly the method employed. The patient is prepared for operation in the ordinary way, and the vulva, vagina, and cervix are carefully disinfected. A longitudinal incision is made, reaching from below the umbilicus as far as the symphysis. After the abdomen is opened the bladder is dissected off the anterior uterine wall. I generally find that it is an advantage to insert a large retractor in the lower part of the abdominal wound so that the lower segment is brought within easy access. A transverse incision is made in the lower uterine segment; Blair Bell has suggested a curved incision as better and employed this incision in a recent case. A suture is inserted at each end of the wound and this is employed to control any laceration at the ends of the wound and after delivery to pull up the wound so that it can be easily stitched. The child is then extracted, in some cases with the hand, in others with one blade of the forceps used as a vectis, and in others with two blades of the forceps which I have only had to do on one occasion. The child having been extracted and the cord tied, the placenta may be removed through the wound if the cervix is not sufficiently dilated, but if the cervix is sufficiently dilated I drop the cord into the uterine cavity and deliver the placenta by the vagina. I then pull up the wound so that it is within easy access for stitching by means of the two lateral stitches already referred to. I then insert three layers of sutures—catgut for the mucous membrane, linen thread for muscle, and a third layer of catgut for tacking back the bladder into its old position. At first I found the operation was a little more difficult than the ordinary one, but recently I have found it quite as simple.

This is not an extraperitoneal incision, and I make no claims to originality as regards the incision; it was employed long years ago. I recommend it simply and solely because I believe that the cicatrix that results will be less liable to rupture.

The advantages of the incision are that one cuts through a less vascular area; the bleeding is extraordinarily slight unless the wound is allowed to extend into the vessels at the side, and this occurred in one of my early cases. In the second place, it is thin and consequently the surfaces can be readily brought together. In one case where I removed a strip of tissue I found the transverse fibres were relatively more numerous than the longitudinal ones, but I cannot be dogmatic on this point, as so far this is the only case in which I have excised any tissue. The third advantage, and it is a very important one, is that the wound in this area is at rest during the early days of the puerperium. If you look at the illustrations of frozen sections of the early days of the puerperium you observe that the lower segment is folded, and we know from practical experience that it is passive. A fourth advantage is that the placenta is seldom encountered. Lastly, there is this great advantage, that owing to the fact that the lower uterine segment does not become fully stretched until labour is well advanced the scar is in a safer region than the ordinary longitudinal one.

I have had two cases of spontaneous delivery after this operation, but in two others Cæsarean section has been employed for the second time. In the last case, when the delivery occurred spontaneously, Dr. Shannon introduced his hand into the uterus and carefully examined the lower segment. He could detect no trace of any wound, nor was there any evidence of thinning of the segment.

I would therefore make a very strong appeal to all those who are interested in this subject to give this operative procedure that I have described careful consideration and a full trial. I may entirely be prejudiced in favour of it, but personally I feel convinced that with this incision, the technique modified in certain details, we shall be able to secure an absolutely sound cicatrix.

Dr. Barris.

If it can be shown that the uterine scar following Cæsarean section is liable to rupture and the life of the mother endangered by a subsequent pregnancy, we must modify our attitude as to the advisability of performing the classical conservative Cæsarean section.

An endeavour has been made to follow up every case of Cæsarean section recorded at St. Bartholomew's Hospital up to 1919. From the results of our figures the following points arise :—

The Risk of Rupture.—Our figures show that out of the forty-eight cases traced no case of rupture of the scar has occurred. The method employed has been the median fundal incision, the wound has been sutured by means of interrupted silkworm gut sutures passed through the muscle layer only and so inserted that the uterine peritoneum and decidua were not included in the ligature. The silkworm gut sutures were buried by drawing together the edges of the uterine peritoneum by means of a continuous catgut suture. Cæsarean section in many instances has been performed several times upon the same patient without untoward result. The appearance of the uterus in cases of repeated Cæsarean section were very instructive. In the majority there was little to show that the uterus had been incised on a previous occasion, the scar when visible appeared and felt firm. In some cases adhesions were found between the scar, omentum and abdominal wall. The results of silkworm gut suture are not entirely satisfactory however. Their persistence has been noted by many observers. During 1907 a patient was admitted on account of metrorrhagia following a Cæsarean section in 1905. After dilating the cervix several silkworm gut sutures were removed from the inner wall of the uterus. On analysing the cases of rupture reported by Mr. Holland certain points stand out clearly, and lead to the conclusion that rupture of the scar is of very rare occurrence provided that catgut is not used and that sepsis does not supervene. Our cases show that 58 per cent. subsequently became pregnant. There is, therefore, a relative sterility, but in addition to the fact that precautions may have been taken, it must be remembered that for the greater portion of the period 1912-18 many of the husbands were serving abroad and home leave was granted only at very rare intervals.

From a consideration of these facts and the figures given us it is evident that in clean cases we are fully justified and are doing the best for our patients if we continue to perform the classical Cæsarean section without sterilizing the patient. The discussion has, however, brought out the fact that it is inadvisable to use catgut and that if sepsis intervenes there is a risk of rupture of the scar should the patient subsequently become pregnant. This danger might be overcome by excising the scar in such cases at a later date as a measure of precaution against this risk.

Mr. Leonard Phillips.

In the Middlesex Hospital cases a most interesting feature was the constancy of anterior placental implantation in repeated sections. In first sections the placenta was often posterior, but in repeated sections it was anterior in every case. It has been suggested that placental implantation on the scar is harmful, through a trophoblastic action, or a liability to retroplacental hæmorrhage. On the other hand I suggest that the reverse may be true. A thick placenta, in apposition with the scar, should act as an internal splint to the latter in labour, tending to prevent thinning of the scar region; also, it may be that placental implantation on the scar is beneficial, securing a period of rest for the weakened scar region, during the most strenuous period of labour.

The Unexplained and High Sterility Percentage.—Thirty-nine of the sixty cases were sterile from two to seven years, mostly three years or over. The patients traced were carefully questioned on the subject of prevention of pregnancy. Excluding cases in which prevention was practised or sterility explained, the percentage remained 52. Nor is there any indication that pyrexia in the puerperium was to blame, for 68 per cent. of the sterile cases were afebrile in the puerperium, while 27 per cent. of the subsequently pregnant cases were definitely febrile in the puerperium. Age and parity did not explain it, for 50 per cent. were primiparæ in the twenties, and 50 per cent. multiparæ over 30 years of age. The frequency of recurrent pregnancy involving four to five or six repeated Cæsarean sections would seem to exclude a possible origin in the operation itself.

The question for practical purposes resolves itself into this: When can we allow subsequent natural labour after a Cæsarean operation? The answer is, when the Cæsarean puerperium is afebrile, the operation performed by a trustworthy surgeon, and the state before labour shows no abnormality or obstruction. All cases must be watched throughout labour and the history, especially the old temperature chart, taken as the guide.

Dr. Amand Routh.

When, at the request of the International Obstetrical Conference, in 1910, I collected 1,282 cases of Cæsarean section performed by over one hundred obstetricians and gynæcologists then living, beginning with one performed by Dr. Lloyd Roberts in 1867, the risk of rupture of the scar in subsequent pregnancies was briefly discussed, more particularly from the point of view of whether sterilization of the patient was justifiable or desirable.[1]

In 1819 Blundell's advice was in favour of sterilization by removing a portion of the Fallopian tube, because of the 95 per cent. mortality of Cæsarean section then present. In 1830 he even advised that women with contracted pelvis should be sterilized in the same way before marriage. At the date of my address, 1910, the mortality of Cæsarean section for contracted pelvis in clean cases was under 3 per cent. and the risk of repeated Cæsarean section in anticipated cases was even less, but there was still a dread lest the scar should give way in subsequent pregnancies before Cæsarean section could again be performed and for this reason fourteen out of the one hundred operators thought sterilization advisable. Little was then known of the number or proportion of cases of ruptured scar after Cæsarean section, nor had the causes of the rupture been ascertained.

Sterilization was effected in the early period of high mortality, by supravaginal hysterectomy with extraperitoneal treatment of the stump, or by removal of a bit of Fallopian tube, only 16 per cent. of Cæsarean sections for contracted pelvis being " not sterilized " up to 1898.

Between 1898 and 1906 the percentage of cases " not sterilized " rose to over 60 per cent., and in the three and a half years to June, 1910, the " not sterilized " cases were 89 per cent. (354 in 395 cases of Cæsarean section for contracted pelvis). This increase of " not sterilized " operations led, of course, to more subsequent pregnancies and repeated Cæsarean sections, so that I find that 112 cases became pregnant out of 669 " not sterilized " cases of Cæsarean section for contracted pelvis, and of these 112 pregnant cases, in 108 repeated Cæsarean sections were performed, in some more than once. Out of these 112 cases which became pregnant, only three seem to have had a subsequent rupture through the scar (Nos. 12, 37 and 38 in Mr. Holland's list). The percentage, therefore, was three ruptured scar cases out of the 112 cases, which are stated to have become pregnant, or 2·6 per cent., but there must have been many pregnancies and, probably, some more ruptures amongst the 354 "not sterilized" cases included in the last three and a half years of my series.

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[1] Amand Routh: "Cæsarean Section in Great Britain and Ireland," 1910, p. 24.

The first repeated Cæsarean sections in my series were by Herbert Spencer, Murdoch Cameron, and Smyly, in 1894. The next was in 1899 (Spencer and Gow), and in the next six years to 1905, fifteen repeated Cæsarean sections were recorded, whilst there were eighty-seven in the next four and a half years, including twenty-one in the six months ending June, 1910, when my series closed. Repeated Cæsarean sections have, no doubt, now become more numerous, and in time will become an appreciable Cæsarean group to help build up the birth-rate, especially if we can reduce the risk of rupture of the scar.

To encourage Perfect Union.—If the position of the placenta can be determined or surmised, when the uterus is exposed, especially in septic cases, the incision should be made elsewhere. It seems clear that transverse fundal incisions are not advisable, partly because the placenta, whether on the anterior or posterior uterine areas, often spreads on to the fundus. Munro Kerr's case (No. 12 in Mr. Holland's series, No. 255 in my series) is an instance of this complication. Cæsarean section should be performed at full time or at the earliest indication of labour so as to encourage perfect uterine retraction. Intra-uterine sepsis is, no doubt, a cause of imperfect union of the incised muscles, especially if the incision has been made through the placental site. Sepsis, even with suppuration of the wound, is not necessarily sufficient to prevent further pregnancies or repeated Cæsarean section. Case 43 in my collection by Sir W. Smyly proves this, and Case 1,045 of my own, where repeated attempts at delivery by forceps had been made during the previous forty-eight hours. Septic sloughs appeared on the child's head and round the abdominal wound, and a utero-abdominal fistula resulted. This was closed when an appendix operation was subsequently performed. This patient went to Canada, and has had two children since, "the same way" as the mother writes, Dr. MacColman, of Winnipeg, performing Cæsarean section on each occasion. How far the use of catgut, apart from sepsis, may in some cases account for faulty muscular union in an intermittently contractile organ is unknown, but there can be no doubt that in the presence of septic organisms catgut would disintegrate much quicker than silkworm gut or even than silk. In 1910 catgut was used for both deep and superficial sutures by twenty-seven operators, whilst forty-one used silk and eight silkworm gut.[1] We shall hear to-day whether catgut is used by more than this proportion. I agree with Mr. Eardley Holland that, theoretically, silkworm gut for the deep sutures is the safest material to use.

Dr. C. OLDFIELD (Leeds).

My list of cases of Cæsarean section (with exceptions as specified) consists of thirty-eight patients operated on by me at the Women and Children's Hospital, Leeds, and three private cases. The report from the Leeds Maternity Hospital includes my cases at that institution. Of these forty-one cases, thirty-seven were "followed up," and twenty-eight were seen by me personally at their own houses. Twenty-one of them had no further pregnancy. I found various explanations of the sterility following Cæsarean section, but the commonest was that precautions were being taken against pregnancy. The reason mostly given was that the patient was afraid to have another operation. I suggest that every patient should be told by the surgeon that she could be delivered safely by Cæsarean section, when pregnancy occurred again, if she came into the hospital just before full term. Sixteen became pregnant, and of these three were delivered through the natural passages at full term; one of them had three natural labours, and two had each a difficult and instrumental labour with a living child; eleven had Cæsarean section twice and one thrice.

Fifty-two Cæsarean sections were done in thirty-nine cases. There was no case of rupture of the uterus.

With regard to the conclusion reached by Mr. Eardley Holland from the analysis of his statistics, I must take time to consider it, before changing my suture material from untanned catgut to any other. Leeds surgeons have used catgut almost exclusively for all operations for nearly two generations and continue to do so. I shall be greatly surprised if it is proved that suturing a Cæsarean section wound with catgut, or rather untanned gut, predisposes to rupture of the uterus. May I suggest that Mr. Holland should compare the primary mortality of Cæsarean section in septic and suspect cases, which presumably are more likely to be followed by rupture, in which silk was used, with those in which catgut was used. It may be that there was a higher mortality after silk than catgut and so more of the catgut cases were left to run the risk of rupture in a future labour? Further, seeing that tanned gut behaves somewhat like silk in a septic wound, he might arrange his statistics to show the proportion of ruptures in (1) untanned gut cases, in (2) silk and tanned gut cases; I fancy the results would show that it was tanned gut and silk and not untanned gut—which favoured rupture, in septic cases.

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[1] *Ibid.*, pp. 23, 24.

Dr. Munro Kerr's suggestion does not strike me as likely to lessen the risk of rupture. I should think the scar in the lower uterine segment would be more likely to give way than in the upper uterine segment, where the muscle is thicker and is not stretched during labour. Moreover, a wound so near the vagina would be in more danger from infection, which would not only increase the risk of the primary operation, but also of rupture in a subsequent pregnancy.

Dr. Herbert Spencer.

I wish to express my high appreciation of the papers read by Mr. Holland and Professor Munro Kerr. To Mr. Holland we are indebted for the collection of an unparalleled list of cases and for judicious comments upon them, and Professor Munro Kerr has given us the benefit of impressions based upon his large experience and has made some stimulating suggestions for the prevention of rupture of the scar.

Mr. Holland has brought together such an enormous collection of facts that I cannot help feeling regret that he should have limited the period of inquiry to the years 1912-18 and that he did not go back to the year 1910, when Dr. Amand Routh's monumental series terminated, and did not base his schedule on Dr. Routh's, collecting all the cases of Cæsarean section from the operators themselves, allowing a little more time for the collection of the records, and giving in one of the columns the result of following up the cases as to rupture of the scar. Such a record would have entailed but little more work and would have added enormously to its value. The limitation of the inquiry to a short period of recent years may give a false impression as to its occurrence, and the exclusion of fatal and sterilized cases (which is quite naturally and properly made from the point of view of subsequent rupture) impairs the records from other statistical standpoints. And I see no reason for excluding from the series of operations in the years 1912-18 cases in which the first Cæsarean section was performed before 1912, for it is obvious that a patient operated on for the first time in 1910 and for the second time in 1912 is just as likely to have a rupture of the scar in a subsequent pregnancy as one operated on for the first time in 1912, and for the second time in 1914.

With regard to the occurrence of rupture of the scar after Cæsarean section I have never met with it after my own or others' operations. In my opinion it ought not to occur in an aseptic case properly sutured, but I do not think it is possible to guard against it in a septic case.

I regret that I have been unable to find time to follow up my cases, but I may say that of sixty-six cases of Cæsarean section which I have performed (fifty-eight hospital and eight private) three died (all infected before operation). Of these, fifty-three were done for contracted pelvis, with one death; thirteen for tumours, accidental hæmorrhage or scar, with two deaths. Excluding the three cases which died, eight cases in which the uterus was removed for tumours, three cases operated on too recently to become pregnant, and six cases in which it is known that precautions against pregnancy were taken, there remain forty-six cases and of these fourteen have become pregnant. In thirteen of these I have performed repeated Cæsarean section (in three cases for the third time and in two cases for the fourth time). In the fourteenth case the patient had a premature child after the Cæsarean section, but had no trouble from the scar.

I regard adhesions over the uterine scar in an aseptic case as due to faulty technique, and as the matter is a very important one and may possibly explain some cases of sterility, I regret that a special column for information on this point was not included in Mr. Holland's schedule. My practice is to use carbolized floss silk of moderate thickness for the deep sutures and a continuous fine silk suture passed parallel to the incision by a fine round straight sewing needle, taking a double grip of the peritoneum and superficial layer of muscle, so that the deep sutures are buried and no suture at all is shown. This method of suture is far superior to the single "Lembert" suture which sometimes cuts out; it entirely prevents any oozing and leads to a scar free from adhesions.

I consider that catgut should be absolutely condemned as a material for suture in Cæsarean section. Its danger was alluded to by Lister himself in his classical lecture on catgut at the Clinical Society nearly forty years ago. It is impossible to ensure its sterility and freedom from the tetanus bacillus; it comes undone as a result of the contraction and relaxation of the uterus; its ends cannot be cut short with safety, and it varies in its absorbability. Chromic gut has been found in the

Cæsarean section wound after ten months. Silkworm gut is an excellent suture for many purposes. My objection to it for closing the Cæsarean section wound is that it is too thin and is apt to cut the tissues, and the ends cannot be cut as short as the ends of silk and are likely to prick the tissues.

Mr. Holland's suggestion to dissect off the peritoneum will prolong the operation at an important stage and may lead to possible oozing in the dead space between the bare muscle and peritoneum. I notice that seven out of the fifteen cases of repeated Cæsarean section were sterilized for contracted pelvis. Having never sterilized a patient for contracted pelvis, and often spoken against it, I will only say here that I consider the operation is unjustifiable on ethical, national and scientific grounds.

I should like to draw attention to the results in cases of eclampsia (the fatal cases of operation having been omitted). Of twelve cases delivered by Cæsarean section only five subsequently became pregnant, and in two of these the scar ruptured with a fatal result. Thus the mortality from this accident alone is 16 per cent., that is to say, it is higher than the total mortality in many extensive series of cases of eclampsia treated without operation in which it is well known that subsequent labours usually take place normally. I have never performed Cæsarean section for eclampsia, the cases in which it is called for being in my judgment rare. I think the results given in this paper may tend to modify the enthusiasm of certain operators.

In many directions Cæsarean section is being performed with a frequency and for indications which are in my opinion unjustifiable. I feel it a duty to state this, in this important meeting discussing Cæsarean section, though I do not go into details which have only an indirect bearing upon the subject of rupture of the scar. Generally I subscribe to the dictum "once a Cæsarean section, always a Cæsarean section." In one case I delivered a child quite easily by the natural passage, in a patient who had had Cæsarean section done by another gynæcologist for "contracted pelvis" which was of such a slight degree as not to require the operation.

With regard to the site of the incision I always make the usual longitudinal suture through the thick part of the body. As to the cervical retrovesical incision it seems to me that it would have advantages in certain infected cases, especially if stitched up with silver wire left long, and subsequently removed through the os. For aseptic cases it has in my opinion nothing to recommend it, the transverse incision being I think specially disadvantageous. The question of the cervical incision, however, will be decided by carefully recorded cases and not by preconceived opinions. The cervical incision like all retroperitoneal incisions postpones considerably the time of delivery of the child which in my last fourteen cases varied from twenty-five to sixty-five seconds from the commencement of the operation, the child being born free from asphyxia and crying immediately after delivery in every case. It would be interesting to hear Dr. Munro Kerr's experience of the cervical incision as affecting the time of delivery and condition of the child.

Dr. Blair Bell.

I am in entire agreement with those speakers who attribute failure of the uterine scar to heal firmly to sepsis in the uterus. I believe that even in the most definitely "suspect" cases an afebrile puerperium can be obtained by sterilization of the uterus and vagina with hyperchlorite solution. I have used Milton fluid, which contains 10 grm. of available chlorine to the litre, and I do not think any harm would result from using it in every case. A large gauze pack, saturated with this solution undiluted, should be left in the uterus, protruding through the cervix into the vagina. It can then be removed when the patient has been put to bed. But in addition to sepsis we must take into account the question of technique in the closure of the uterine wound. Personally, I prefer to make the opening in the uterus as high as possible. I have operated through the lower uterine segment in the way described by Professor Munro Kerr, but there is this difficulty: until one sees the lower uterine segment one is never certain whether it will be wise to make an incision in this region. I have found this situation may be unsuitable owing to the presence of a large venous plexus running across the utero-vesical pouch. In these circumstances, if one has made a sub-umbilical laparotomy incision, it is necessary to enlarge the wound upwards. Moreover, all cases of placenta prævia must be excluded. For these reasons, and because I have never had any trouble with the Cæsarean section scar, I shall in future confine my operations to the upper uterine segment. As a matter of interest, I may mention that I have a patient on whom I have performed two Cæsarean sections. In the first operation the wound was made in the upper segment, and the last time through the lower uterine segment. It will be interesting to see which scar stands the next pregnancy best. The scar in the upper uterine segment was indistinguishable at the last operation.

The technique I employ for the closure of the uterine wound is the same as that I use in the performance of colporrhaphies—namely, mattress sutures of chromic catgut are first inserted to bring together the deeper parts of the muscle wall. The same stitch is carried over to bring together the superficial parts of the muscle wall and the peritoneum. A large ridge as thick as a finger results from this method of closing the uterine wound.

Dr. E. O. Croft.

I have had no personal experience of rupture of the Cæsarean scar, and consider that the essential factor in its prevention is that sound fleshy union should be obtained through the whole muscular wall, and that no portion of the decidual layer should become inverted or included between the united muscle. In order to obtain this union the sutures should be inserted not too near the cut edge, and should include a considerable portion of the uterine wall. The use of a full curved needle, giving the suture a circular track, prevents the formation of a concavity between the middle layers of the cut wall. The stitches should be numerous, not more than half an inch apart, and should invariably be interrupted. A continuous suture is liable to become loose as the uterus shrinks. I have seen a post-mortem on a patient in which this happened. I have many times operated for the second and third times on the same patient, and have been surprised at the almost complete invisibility of the old wound.

I am a strong advocate of the use of silk for the deep sutures. It can be readily sterilized by boiling, and it does not slip in tying. The objection that it is more liable to become infected is, I think, fallacious. In a case known to be infected (a tubo-ovarian abscess was removed at the time of the operation) the uterine wound sutured with silk remained intact and healed. In two cases dying of independent disease after twelve and fifteen months respectively, a careful examination of the uterine scar revealed no trace of the silk, which had been completely absorbed. A quite moderate degree of infection in a catgut suture would lead to its speedy dissolution and non-union of the wound.

Mr. Furneaux Jordan.

In the period under review I have reported seventy-two cases of Cæsarean section. Of these I have traced and seen personally all but seven. Since sending my report to Mr. Eardley Holland, two out of the seven have turned up at the out-patients department, both pregnant again and both willing to have another Cæsarean section. I have done nineteen repeated Cæsarean sections, three of them being third Cæsareans. I have had no experience of rupture of the scar, and in my repeated Cæsareans I have, as a rule, been unable to find any trace of the scar of the first operation. I have not found any weakness, though I must confess that I have not felt for it from the inside of the uterus. I always make my uterine incision as near the middle line as I can judge, and it is most likely that the second incision would be over the site of the first one. I suture the uterine incision by one continuous catgut suture, passing the needle right down to, but not including, the endometrium. I take up plenty of muscular wall at each side, and I pull the suture up quite tightly, as tight as I can. I believe sepsis to be the cause of rupture, and that the material used is immaterial.

I received through the kindness of Mr. Eardley Holland, a copy of his report, and I was very much impressed by the relative sterility due to the large number of women who are "taking precautions" because they do not want to have another Cæsarean section. I think that this fear of a second Cæsarean is largely due to the attitude that that we ourselves have taken towards this operation. Up to fairly recent years it has been regarded as a wonderful operation; a great fuss was made of it, in a nursing home every nurse would be brought in to see it, and finally even the baby would be named after the surgeon who did the operation. Can we be surprised that the patient and her husband take the view that having got through such a marvellous operation successfully they are not going to take the risk again! They are going to leave well alone. For the last few years I have impressed upon patients that it is one of the safest and easiest operations in surgery, that they can easily have a second or a third, and I never now advise sterilization. As a result of this, hardly any of my patients are "taking precautions," and at the present moment nine of them are pregnant.

The cases that are serious, that may be most serious both for the mother and the child, are those that come into the hospital, having been in labour for three or four days, and on whom repeated attempts at delivery have been made. If the child is still alive I do a Cæsarean, and Dr. Blair Bell may be interested to know that for some years now I have, in those cases probably septic, poured a jug of biniodide lotion through the uterus. I swab it out thoroughly with the lotion, and on pouring in from above through the uterine incision the lotion runs out freely through the dilated cervix below. I believe that by adopting some such method as this we can operate on cases that otherwise would require craniotomy, and so save a number of infants.

Dr. FOTHERGILL.

Now that Cæsarean section is done for so many conditions quite apart from mechanical obstruction, the question of the scar assumes great importance no doubt. Still it should be approached with common sense, and we should endeavour to take advantage of the experience of others. A good deal of investigation done by Americans during recent years led up to the conclusion that, in the absence of mechanical obstruction, and if the recovery from previous sections has been free from fever, all that is strictly necessary at subsequent labours is to keep the patient under skilled observation. The points brought out in the present discussion do not appear to warrant any advance from this position. I think that perhaps too much stress has been laid upon details. I have sutured with silk and with various kinds of catgut, and on subsequent occasions have seldom found fault with the scars. I now sew up with anything that the nurse gives me. Adhesions are avoided by making the incision in the abdominal wall high up, half of it being above the umbilicus. Thus when the uterus has been emptied and sutured, the visceral incision lies below and not opposite the parietal wound. I make no attempt to disinfect the uterine cavity or the parturient canal. I have never sterilized except in the case of one woman, and that was done by request after I had delivered her five times by Cæsarean section. She makes her living as a "child dancer," having straight legs, though her backbone is sigmoid in form. I must confess that I have always carefully avoided cutting into the lower uterine segment on account of its proximity to the vagina and to the bladder, and because of the multitude and size of the venous structures which surround it. Thrombosis of the sinuses with subsequent embolism constitutes to my mind a real danger. An operator should not be dominated by the fear of raising his mortality, and those who interfere whenever there is a chance of saving life must face the risks of occasional death. But one should not, I think, undertake extraneous risks —namely, risks which are not compensated for by the definite prospect of advantage to the patient. Thus before adopting the incision through the lower uterine segment, one would like to have the results of a few hundred cases. We cannot all be pioneers.

Dr. GOUGH.

I have performed Cæsarean section on one hundred occasions, in eighteen cases for the second time and in five for the third time. All have been done for contracted pelvis, none for any of the more recent indications. In all cases I have used twenty-day catgut as suture material. My suture has been a continuous one in two layers, the first taking in the inner half of the muscle, just missing the mucosa; the second taking the outer half of the muscle and the peritoneal edge. The sutures are introduced with a half-circle Hagedorn needle and a wide hold of the muscle is taken. This gives a firm flat approximation of the cut surfaces throughout the depth of the wound. If this object is obtained, in my opinion the nature of the suture material matters not at all. All repeat operations have been allowed to go into labour (one for seventeen hours) but in no case has any sign of threatening rupture of the scar been noted. In one or two cases a thinning of the scar from within, as described by Dr. Munro Kerr, was present.

I should expect that in operations done for toxæmic conditions, with degeneration of the uterine muscle-fibres, a less firm union would be obtained. As these are the very cases which will be allowed to try to deliver themselves in future labours they should be specially liable to rupture. I should be glad if Mr. Eardley Holland can tell us whether his reported cases bear this out.

Dr. W. FLETCHER SHAW (Manchester).

At this late stage in the discussion I only wish to mention two points:—

First, the Suture Material.—I always use chromic catgut and although I have now performed this operation upon 150 patients I have only had one ruptured scar in a subsequent pregnancy, and this in a patient who was allowed to proceed well into the second stage of labour with the intention of allowing her to deliver herself by natural forces, the Cæsarean section having been performed for an ovarian tumour obstructing labour and not for contracted pelvis. The figures given by Mr. Eardley Holland do seem very convincing that catgut is an unsafe suture material and he has put his results before us with such a freedom from bias that we must of necessity carefully consider this question. To do this thoroughly it is necessary to consider carefully each of the cases of rupture which he has reported. At the same time I cannot help thinking that some abnormal features, other than the suture material, must have been present in these cases of rupture, as all the members taking part in this discussion who use catgut have had so few cases of rupture: Dr. Gough, 100 cases; Dr. Oldfield, fifty cases; Dr. Fothergill, a large number; Dr. Blair Bell, a large number; all without rupture, and myself, 150 cases with one rupture; nor have any of my colleagues at St. Mary's, Manchester, had a case of rupture during this time. It is possible on further investigation that the cases of rupture published may have been septic, have had a toxæmia, been badly sutured, or may have been allowed to continue long in labour.

The second point I am sorry has been very little discussed by the previous speakers: Is it justifiable to allow a patient to have a natural labour after Cæsarean section? Cæsarean section is now frequently performed for conditions other than contracted pelvis, placenta prævia, eclampsia, &c., and there is no anatomical reason why a subsequent labour should not be *per vias naturales*. Since 1912 we have had four patients at St. Mary's who were allowed to deliver themselves naturally after Cæsarean section at a previous confinement; three were quite successful, but the fourth, my own case, ruptured in the second stage. This is the only case of rupture of the scar in the period under revision: that is to say, all the scars stood the strain of pregnancy, but of those undergoing the strain of labour, one ruptured out of four—twenty-five per cent. These figures are very small and it may be a long time before we have another case, but they do make one pause and carefully consider before recommending normal delivery after previous Cæsarean section.

Dr. J. W. Bride (Manchester.)

The figures for Cæsarean section at St. Mary's Hospital, Manchester, are given in the table in Mr. Holland's paper. An analysis of certain interesting points is as follows: Ninety-six of 190 cases treated have not become pregnant since Cæsarean section, that is a relative sterility of 50·5 per cent. Of these cases, twenty-two took precautions against pregnancy, four were widowed, and three died of non-pelvic conditions at a later date; in one case the husband had been on active service since. This accounts for thirty out of ninety-six not becoming pregnant. The remaining sixty-six state they took no precautions, therefore the relative sterility is reduced to 34·7 per cent. Of the ninety-six cases fifty-three had pyrexia, i.e., 55 per cent.

Patients who subsequently became Pregnant, and were delivered by Natural Passages.—There were four of these, two were delivered naturally, one of one, the other of two living children. The third had craniotomy and Cæsarean section later again. In the fourth case, the scar ruptured and the patient died. Thus of the four cases in which natural delivery was attempted there was a mortality of twenty-five per cent. from rupture of the Cæsarean scar.

Repeated Cæsarean Sections.—There were sixty-eight cases. In each the indication for Cæsarean section was contracted pelvis, with five exceptions. Twenty-one were allowed to go into labour and forty-seven were not in labour. There was no case of rupture of the scar. In only one case was silk used. Forty-four had some degree of pyrexia, i.e., 66 per cent.

The Case of Rupture of the Scar.—M. S. was admitted to hospital on November 24, 1916, with an ovarian cyst obstructing labour. Dr. Shaw performed Cæsarean section and right ovariotomy. Early in 1919 she was seen by Dr. Shaw in the out-patient department and he decided to let labour proceed normally as there was no pelvic contraction. The patient was admitted in labour at 2.40 a.m. on May 14, 1919, and in good condition. Some very strong pains and slight bleeding from the vagina occurred at 5 a.m. At 8 a.m. the patient had a running pulse of 140, and a subnormal temperature.

On abdominal palpation it was obvious that the uterus was ruptured and she was immediately taken to the theatre and the abdomen opened. The fœtus was free in the peritoneal cavity and dead. The uterus was inverted through the old scar which had ruptured and the placenta was adherent to the inverted uterus. The peritoneal cavity was full of blood. The child and placenta were rapidly removed, the inversion corrected and supravaginal hysterectomy performed as quickly as possible. The patient left the table in a very critical condition, and died at 7 p.m. from collapse and shock.

There are twenty-one cases pregnant now. The only comment to be made is that several of these cases show an interval from child-bearing which corresponds with an interval of absence of the husband on active service.

I think that a scar in any part of the body—just as a puncture repair is a weak spot in a pneumatic tyre—is liable to give way under strain, and it would appear doubtful to me if it is ever good practice to subject a scar in an organ so liable as is the uterus to excessive distension and powerful contraction to the strain of labour.

I do not intend to discuss the question of suture media, but simply state that, with perhaps half a dozen exceptions, two layers of catgut, sometimes chromicized, have been used in all the cases in this series.

I think I may fairly say that what the figures of the St. Mary's Hospital, Manchester, do show is that repeated Cæsarean sections may be undertaken many times with impunity and the risk in the early stages of labour appears negligible. I assisted Dr. Fletcher Shaw to perform Cæsarean section for the seventh time on the same patient last year. She was in labour four or five hours before operation and the uterus, though adherent, was well healed in the scar. She was sterilized on this occasion.

Mr. CLIFFORD WHITE.

There are two theoretical considerations that have an important bearing on the question of the suture of the Cæsarean incision. The first is that the uterus is the seat of intense autolysis, as is shown by the weight diminishing from about 2 lb. to 2 oz. in a few weeks. This autolysis is most rapid in the first few days and it is not fair to expect an absorbable suture like catgut, which is standardized for absorption in ordinary muscle, to withstand digestion in an organ where autolytic action is proceeding with such violence.

Secondly, a continuous suture is unsuitable for holding the wall of the uterus in close apposition because the uterus is involuting at the rate of over half an inch in twenty-four hours. Hence a 5-in. uterine incision is only 3 in. long on the fourth day and therefore any continuous suture must become slack and incapable of holding the uterine wall closely together. This applies to some extent to the use of mattress sutures. As the uterus is diminishing so rapidly in size, the interrupted sutures must be tied much more tightly than is usual in other surgical procedures, otherwise they will become loose in a few days. The rhythmic contractions and relaxations of the uterus will accentuate this tendency.

It would seem, therefore, on theoretical grounds that a weak scar is particularly likely to occur (1) with catgut, and (2) when continuous sutures are employed, and conversely, a strong scar should result when a non-absorbable interrupted suture is employed.

My personal experience is of seventy cases of Cæsarean section. Of these, eight were Cæsarean hysterectomies, leaving sixty-two cases in which the scar might yield. None were sterilized. In every case I have used interrupted sutures of silk or linen thread. I have never seen or heard of any yielding of the scar in any of these cases. Of the sixty-two cases seven had more than one Cæsarean operation—two patients having Cæsarean section performed three times, and five on two occasions. In each case the scar was sound and in only one was the scar very easily noticeable. In addition to these, several cases have come to my knowledge where patients have had normal or forceps deliveries after Cæsarean sections for eclampsia or placenta prævia, and in no case has there been symptoms or signs of rupture. In one case of Cæsarean section for eclampsia in two successive pregnancies the scar was not found to be weakened when seen at the second operation. This shows that toxæmia does not necessarily cause imperfect uterine union.

Dr. Lapthorn Smith.

I should like to say a few encouraging words on the success attending Cæsarean section. I fear lest the figures given may unduly depress the younger members present. With regard to the suture material, Pagenstecher's celluloid linen thread seems to possess all the advantages of silkworm gut without its sharp irritating points. I have used it for many years.

Mr. Eardley Holland (in reply).

Many points have been raised in the wide discussion that has followed the opening papers ; most of these have been already dealt with by other speakers so, especially as the hour is late, I shall confine my reply to a very few remarks.

I think the most important thing that has been unearthed by this collective investigation, apart from the frequency of ruptured scars, is the danger of catgut. I must confess to a feeling of disappointment that my figures have not carried conviction to all the catgut users, but I feel they have been badly shaken, and that in time they will renounce this dangerous suture material. After all, it is difficult for a surgeon who has been employing catgut for Cæsarean section for many years without accident to bring himself to give it up, even in the face of strong evidence as to its danger. Personally, I believe the evidence I have brought forward is incontrovertible. If asepsis of the uterine wound could be guaranteed I believe catgut might be a suitable material, although, as Professor Munro Kerr and Mr. Clifford White have pointed out, the intense autolysis which occurs in the puerperal uterus is likely to lead to the rapid absorption of catgut. But asepsis, I am convinced, cannot be guaranteed in the uterine wound, for the incision is into a mucous cavity in close proximity to a contaminated area (the vulvo-vaginal tract).

Silk is not an ideal suture material : silk has serious disadvantages in the presence of sepsis ; as is well known, a suppurative process goes on almost indefinitely until the silk sutures either come away or have been removed. The ideal material is silkworm gut, which is an inert substance in the presence of bacteria. Dr. Herbert Spencer's remarks have been an outstanding feature in the discussion ; he has always been a strong opponent of catgut and what he has said will have a great effect on the opinion that those present will carry away with them. Dr. Spencer would have liked the period I selected for investigation to have been extended backwards, including earlier years ; the almost insuperable objection to this is the difficulty in following up patients who were operated upon at so remote a period ; as it was, the follow-up success was not more than 70 per cent. Mr. Oldfield, an inveterate user of catgut, and one who I am afraid will be slow to reform, complains that catgut has been attacked severely ; it may have been attacked severely, but I maintain that it has been attacked fairly, justly and without prejudice. He asks me if the immediate results of the operation were worse after silk than after catgut. I will examine the lists of cases and see if I can throw any light upon this point and will let him know. Mr. Gough has made a good point when he asks if the scar is especially liable to rupture when the operation has been performed for eclampsia or albuminuria. In the eighty-seven reported cases in which the indication was mentioned the operation was performed for these indications on fourteen occasions, and in the eighteen cases of rupture reported in the present series, on three occasions. These figures tend to support Dr. Gough's view that toxæmia of pregnancy may interfere with the healing of the incision. Dr. Blair Bell asks me if the catgut that was used in the fifteen cases of rupture was plain or chromic; it was chromic in all cases. I am favourably impressed by his method of suturing the wound by mattress sutures, and will certainly try it in future cases. The question of sterility following the operation has been mentioned by several speakers, notably by Dr. Bride and Dr. Lionel Phillips. Both of these speakers have gone into the question in some detail in their lists of cases, and I am in complete agreement that the figures want very careful interpretation before an opinion is arrived at; the point is well worth working out, and this can be done at leisure from the tables, when they are published in full in the *Proceedings*. Mr. Furneaux Jordan's remarks on sterility have made a great impression on me.

I wish once more to lay stress on the necessity of working in large figures for coming to any decision in the matters that have been under discussion. A small sample of cases may give the most misleading results, as, for example, the London Hospital sample, which gave a rupture percentage of 16, in contrast with other lists which gave a rupture percentage of zero.

In conclusion, I wish once more to give my most sincere and heartfelt thanks to my fellow obstetricians in Great Britain, who have so generously responded to my call for a collective investigation. The collection of these lists has occasioned an amount of careful work to those who have undertaken the task. It is the utmost gratification to me, as I am sure it is to them, that our united work has been so successful, and has revealed so many outstanding facts in a subject of such immense importance to all of us.

Professor MUNRO KERR (in reply).

I thank the various speakers for their remarks and criticism on the papers which have just been read by Mr. Eardley Holland and myself. The arguments advanced against the incision I proposed are those I expected. I specially wish to thank Dr. Blair Bell for his criticism, and for having given the incision a practical trial. I think Dr. Bell's suggestion of making a curved incision instead of the transverse incision a distinct advantage. I am surprised, however, that Dr. Bell should desist from the lower segment incision because he had to deal with a placenta prævia, for after all in 40 per cent. of cases of the ordinary longitudinal incision the placenta is directly encountered over the incision; it is really a placenta prævia *qua* this incision.

As regards the other case in which there was varicosity of the veins over the lower segment, I do not think that need have been considered a contra-indication. In many cases of ordinary Cæsarean section one finds the vessels considerably distended over the anterior uterine wall. I have not found any trouble with the bladder, or any subsequent cystitis, or that cystitis is more liable to occur in the eighteen cases where I have employed the lower uterine segment. I wish it to be understood that I have no absolute convictions regarding this incision. Time only will show whether or not it gives a sounder cicatrix. It may be that in five or ten years I will be convinced that it does not possess the advantages that at present I believe it to possess. I am convinced, however, that a sounder cicatrix will be secured. The only matter regarding which I am a little uncertain is whether or not infection of the wound is more likely to occur with this incision than with the longitudinal incision, a very important point indeed, especially emphasized by Dr. Fothergill. So far I have had one death in eighteen cases.

Finally, I desire to support the statement made by Mr. Eardley Holland that the weakened uterine scar from the ordinary longitudinal incision does not necessarily contain a relatively greater amount of fibrous tissue. In connexion with this matter, I would mention a case of uterus bicornis unicollis, in which I resected the uterus and made a single cavity, approximating the cut uterine surfaces with threads of fine silk. This patient went through a normal pregnancy, through a prolonged labour, and was finally delivered with forceps of a living child, although the child was injured with the forceps and died some twelve days later. After removing the placenta I passed my hand into the uterus and could detect a distinct ridge over the posterior upper and anterior wall of the uterus. The patient is at present pregnant for the second time. I hope to publish this case after her next confinement.

Section of Obstetrics and Gynæcology.

President—Mr. J. D. Malcolm, F.R.C.S.Ed.

The Pathology of Utero-placental (Accidental) Hæmorrhage.[1]

By Gordon Ley, F.R.C.S.

(From the Pathological Institute of the London Hospital—Professor Hubert M. Turnbull.)

At the meeting of the Obstetrical Section of the Royal Society of Medicine in March, 1920, I read a paper on the clinical aspects of accidental hæmorrhage and promised the paper on the pathology. Before I describe the results of my own investigation into the pathological processes, I shall review the literature which has already been published upon this aspect of the subject.

Review of Literature.

The pathological work carried out by numerous investigators has been considerable. The uterine musculature, blood-vessels and decidua, and the placenta have come under notice and, further, studies of the other organs at necropsy have been made. It seems best to take up these structures separately, and briefly to record the conditions noted by different investigators. The uterine musculature has been particularly studied by Couvelaire, 1911 [9], Essen-Möller, 1913 [12], Whitridge Williams, 1915 [35], Zarate, 1915 [38], Seitz, 1903 [30], and von Weiss, 1897 [34]. The decidua by Seitz [30], von Weiss [34], Schickele, 1904 [29], Zarate [38], and Biancardi, 1905 [5]. The uterine blood-vessels by Whitridge Williams [35], Seitz [30], von Weiss [34], and Essen-Möller [12]. The placenta by Young, 1914 [37], Biancardi [5], Seitz [30], and von Weiss [34]. The organs at necropsy by Couvelaire, 1912 [8], Bar and Kervily, 1906 [3], Hartmann, 1907 [17], and von Weiss [34].

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[1] At a meeting of the Section, held July 8, 1920.

THE UTERINE MUSCULATURE.

Macroscopically, peritoneal ruptures and external, superficial ruptures of the myometrium have been noted by von Weiss [34], Kouwer, 1908 [23], Hicks, 1861 [18], Engström, 1911 [11], Lieven, 1914 [24], Zweifel, 1912 [32], and Shaw, 1914 [31], and have been given special attention by Knauer, 1903 [22], who attributed them to sudden severe distension, and by Fraipont, 1914 [14], who attributed them to intramuscular hæmorrhages, diminished elasticity and friability of the uterine wall.

Inter- and Intra-fascicular Hæmorrhages in the Uterine Musculature: "Apopléxie utéro-placentaire" Couvelaire, 1912 [8].—These have been noted by numerous authors, particularly by Couvelaire [8], who first accurately described the condition. Secondly, by Zarate [38], Fabre and Bourret, 1912 [13], Zweifel [32], Berggren, 1912 [4], Spaeth, 1913 [28], Jennter, 1913 [19], Fraipont [14], Clifford, 1914 [7], King, 1914 [21], Young [37], Brandt, 1914 [6], Shaw [31], Knauer [22], Seitz [30], Targett, 1905 [33], Le Lorier, 1906 [25], Bar and Kervily [3], Keyworth, 1909 [20], Munro Kerr [27], and Whitridge Williams [35]. Hæmorrhages into the broad ligaments and Fallopian tubes have also been described by Couvelaire [8], Whitridge Williams [35] and Berggren [4]. Whitridge Williams described an extensive hæmorrhage into the right ovary, and Couvelaire described and illustrated in colour, one case where there were numerous punctiform and streaky hæmorrhages into both ovaries. Microscopically the hæmorrhage into the uterine wall is described by all authors somewhat as follows:—

The muscle bundles are separated and split into little bundles by streaks of red blood cells which dissect the individual bundles and, indeed, often separate cell from cell. These hæmorrhages are sometimes more numerous near the peritoneum, sometimes near the decidua. They are usually more numerous in the region of the placental site. Zarate [38] recorded one case of great importance as it gives evidence of the presence of focal hæmorrhages and necroses which preceded the accidental hæmorrhage. In a case of accidental hæmorrhage associated with eclampsia which came to necropsy he found both recent and old hæmorrhages in the uterine musculature. He says: "The antiquity of the hæmorrhages is shown by their differential coloration with eosin. The attention is attracted by the great quantity of connective tissue surrounding degenerated muscle bundles. This degenerated tissue, associated with an infiltration by round cells, is most noticeable in the areas where the older hæmorrhages are." This means, I take it, that there have been an infiltration and replacement by fibrous tissue of degenerated muscle in the region of the older hæmorrhages.

Œdema of the inter-fascicular connective tissue has been described as frequently present by many authors, especially by Couvelaire [9] and Whitridge Williams [35].

Leucocytic infiltration of the musculature is noted particularly by von Weiss [34] who held that it was the cause of the condition. In his specimens the inner layers of the uterine musculature showed the most marked leucocytic infiltration, that in the outer layers being of the nature of a perivascular infiltration. It is significant that in four out of the five cases in which the uterus was examined, it had been plugged during life with iodoform gauze. This alone would give rise to leucocytic infiltration. The case that was not plugged showed the least leucocytic infiltration. Two of his cases showed an increase in the connective tissue of the uterine wall. Leucocytic infiltration of the musculature of slight degree around the older hæmorrhages is also recorded by Zarate [38] in one case, to a slight extent beneath the decidua in one case by Seitz [30], and in one case to a slight extent with a perivascular distribution by Couvelaire [8]. It is recorded as absent by Berggren [4], Essen-Möller [12], Couvelaire [8], and Whitridge Williams [35].

Degeneration of the Individual Muscle Fibres is recorded by Seitz [30] in two cases, by Hartmann [17], and in one case by Zarate [38], who said "some of the muscle fibres were entirely degenerated. Others showed the characteristic vacuolation of fatty degeneration." Degeneration was not noted by Couvelaire [8], Essen-Möller [12], Whitridge Williams [35], or Young [37].

THE UTERINE BLOOD-VESSELS.

Changes in the blood-vessels were noted by Whitridge Williams [35] and Seitz [30]. They were found in the smaller blood-vessels by Whitridge Williams in two cases, who thus described them : "In some of the smaller arteries the intima was swollen and projected into the lumen. It was conspicuous on account of the diffuse blue staining which it assumed. In such areas the finer architecture of the vessel wall was disturbed and peculiar defects were seen which appeared as clear circular or elliptical zones, while in other places irregular blue granules were formed which stained very intensely with hæmatoxylin. Throughout these areas nuclear fragmentation and atypical arrangement of cells was observed. In several places defects were present in the intima of the larger arterioles which may have been connected with the hæmorrhagic areas in their vicinity. In the walls of many of the larger veins free hæmorrhage had occurred, just beneath the endothelium, which communicated freely with the hæmorrhagic effusions between the muscle fibres. Similar changes did not exist in the main blood-vessels." "In conclusion," he said, "careful study of the arterial lesions in my specimen has led me to believe that they are toxic in origin and are due to the action of some substance circulating in the blood, which possibly also produces changes in the smallest arterioles and capillaries which permit the escape of blood into the tissues just as is observed in certain varieties of snake poisoning."

Seitz found changes in the blood-vessels beneath the placenta of the nature of a marked proliferation of the vascular endothelium with narrowing of the lumen.

The vascular changes described by Seitz, and the changes in the vessels, apart from hæmorrhage, which were described and figured by Whitridge Williams, appear to be identical with those normally taking place in the sub-placental vessels at or about term; they have been described in full by Goodall, 1910 [39]. Lacerations of the walls of some of the blood sinuses were noted by Couvelaire [8]. By many authors the blood-vessels are described as being normal, noticeably by Couvelaire [8], Berggren [4], Essen-Möller [12], Fabre and Bourret [13].

THE DECIDUA.

Hæmorrhage into the decidua has been noted by all observers. Such hæmorrhage is, of course, a natural association of labour.

Leucocytic infiltration of the decidua has been noted by many observers, especially by von Weiss [34], Seitz [30], who recorded its presence in one case but not in another, and Biancardi [5], who described it as more or less well marked in two of nine cases. Von Weiss in several of his cases found extreme leucocytic infiltration of the uterine but not of the placental decidua. This infiltration was conspicuous only in the cases in which the uterus had been packed with iodoform gauze and was present in all such cases. With little doubt the packing was responsible for the infiltration. Inflammatory decidual changes were not present in the cases described by Couvelaire [8], Berggren [4], Essen-Möller [12], Whitridge Williams [35], Gottschalk, 1897 [16], and Zarate [38]. No micro-organisms were found by any observer.

Degenerative changes in the decidua were observed by Seitz [30], who considered the retroplacental hæmorrhage to be a phenomenon secondary to decidual necrosis or inflammation. He stated that "where the hæmatoma is intraplacental the decidua is still necrosed. Such necrosis cannot be due to compression by the hæmatoma. We have found the cause of the pathological changes in the placenta to reside in the inflammation and degeneration of the decidua basalis." He considered the degeneration of the decidua, which he found most marked in the decidua basalis, to be due to vascular changes or chemico-toxic influences. Von Weiss [34] described extensive decidual necrosis in one case, focal decidual necrosis in two cases, and no necrosis in two cases. The necrosis, when present, was always most marked in the decidua basalis. Decidual degeneration was also described by Schickele [29], who attributed it to a lack of blood supply to the decidua, which produced a slow necrosis. This lack of blood supply he considered to be in part the result of uterine contractions, in part the result of thrombosis of the subplacental sinuses. He said that "owing to the lack of knowledge of the changes in the blood-vessels towards the end of pregnancy one was not able to attribute the decidual changes (necrosis) to pathologic changes in the blood-vessels, but there is a definite poverty of blood-vessels in the region of the placental site. There is seen a defective nutrition of the decidua and a slow necrosis."

Biancardi [15] in nine placentæ from cases of accidental hæmorrhage found in the decidua hæmorrhagic foci in various stages of retrogression, deposits of fibrin, distension and thrombosis of blood-vessels, and thickening and degeneration of the decidual elements, varying from cloudy swelling to complete necrosis. "These changes are," said he, "always more marked in the region of placental detachment." He considered the decidual degeneration to be the cause of the placental changes which he described in detail. He admitted, however, that apart from hæmorrhages and leucocytic infiltration, these decidual changes are found in the decidua of the normal placenta. He attributed the decidual degeneration to deciduo-ovular toxic products or fœtal toxins.

Gaston [15] found that Nitabuch's fibrin layer was thickened and the decidual cells were blurred and contained poorly stained nuclei. He considered that decidual hæmorrhage was the primary cause of placental separation. Gottschalk [16] found "extensive decidual degeneration in excess of the normal with focal areas of complete necrosis. Emboli, some recent some old, in the decidual blood-vessels."

He considered that the thrombosis was secondary to necrosis of the vessel walls and that this in turn was secondary to defective decidual blood supply. The hæmorrhages he attributed to local increase of blood-pressure, the result of occlusion of capillaries. He was of opinion that "the kidney of pregnancy" and retroplacental hæmorrhage were secondary to decidual necrosis, this in turn being due to defective blood supply. The renal changes he considered to be set up by liberated albuminuric poisons.

PLACENTAL CHANGES.

The changes in the placenta, described by many authors, consist purely of the various stages of infarction. They have been carefully studied by James Young [37]. Apart from stages of infarction, which are mentioned by all authors, little else has been described. Essen-Möller [12] stated that the degenerative changes found in the placenta are not characteristic of utero-placental apoplexy but may occur in other conditions as well. Gaston [15] found thick vessels in the villi, but no peri- or endarteritis. Seitz [30] found round-celled infiltration of those villi which lay in contact with the degenerated decidua, and considered this to be "*inflammatio per contiguitatem.*" He also noted fibrous hypertrophy of von Franqué (concentric stenosis) of the vessels in villous stems near infarcts, and considered it secondary to vascular stenosis and occlusion in the infarcted area. He further found syncytial hyper-activity in one case. This latter condition was also noted by von Weiss [34] in two cases. The paucity of changes described in the placenta, apart from those due to infarction, is noteworthy, when one considers the numerous changes described by various authors in the other structures discussed.

CHANGES IN OTHER ORGANS.

Excluding those cases in which the condition was associated with eclampsia there are not many recorded cases in which changes in the organs are described. Bar and Kervily [3] recorded a case which is of such importance that I quote it at length.

A VI-gravida; thirty weeks pregnant. A typical case of internal hæmorrhage treated by de Ribes' bag. Patient became worse. Cæsarean section performed. Uterus contracted well. Sutured. Death. Necropsy: The liver was pale and yellowish, suggesting an early fatty change. The centres of the lobules appeared as yellow dots. There were no hæmorrhages. Microscopically in the portal zones the liver cells were normal. In the central zones the liver cells were shrunken and often ragged. The cytoplasm was pale, the nuclei (sometimes free, sometimes only surrounded by a little shrunken cytoplasm) were shrunken, and pale or hyperchromatic. The area affected was the inner half of the lobule. Sections stained with osmic acid showed fine fatty granules in the cells throughout the liver, but more numerous in the cells around the central veins. The kidneys were large and pale. There was granular degeneration of the cytoplasm of some of the cells of the convoluted tubules. There were casts in the tubules of the loop of Henle.

Bar and Kervily arrived at the following conclusion from this case, that: "If researches show that hepatic lesions similar to these are characteristic of uteroplacental apoplexy it will be proved that retroplacental hæmorrhages are not merely vaguely allied to nephritis but are directly allied to a complex state which one of us, Bar, calls eclampsism."

Von Weiss [34] found degeneration of the renal parenchyma in three cases. In one the epithelium was swollen; there were hæmorrhages and granular discoloured hyperæmic foci devoid of nuclei. In one there were swelling and focal necrosis of the epithelium of the convoluted tubules. In one there were swelling and granular opacity of the epithelium of the convoluted tubules, the lumina being frequently occupied by shed cells; there were also focal areas of destruction of cells and disappearance of nuclei. The same author found liver changes in two cases. In one the liver cells were swollen and discoloured; in the other the cells were large and swollen. In this case he also recorded subendocardial ecchymoses.

Knauer [22] found subendocardial ecchymoses in the left ventricle in one case, subacute nephritis with hæmorrhage in the second case, and chronic nephritis with atrophy of the kidneys and hæmorrhages into the liver in the third case. Hartmann [17] found fatty infiltration in the liver, and, in one case, small blood extravasations in the liver without necrosis or thrombosis.

PERSONAL OBSERVATIONS.

My material consisted of three uteri removed for accidental hæmorrhage from Cases 27, 37 and 41 of my paper upon the clinical phenomena, of the kidney and liver of Case 27, the kidney of Case 37 and of the kidney, liver, myocardium, diaphragm and spleen of Case 41. In one of these uteri there was spontaneous rupture. Further, I have taken as controls five uteri removed, at or near term, before or after death: (1) A uterus removed by operation from a case of rupture, the result of obstructed labour due to an impacted breech presentation with extension of the legs. (2) A uterus removed by operation from a case of rupture due to obstructed labour. (3) A uterus from a case of placenta prævia in which during the performance of bipolar version the placenta was widely separated. A leg was then brought down. The uterus was at the time in a state of atony produced by chloroform. There resulted, therefore, extensive intra-uterine hæmorrhage, which caused the death of the patient in less than a quarter of an hour. The uterus was removed immediately after death and showed no microscopical change. (4) A uterus removed by operation from a case of rupture. In this case there was no absolute obstruction although there was considerable delay and slow advance due to a minor degree of contraction of the pelvic outlet. There was, further, a very considerable degree of albuminuria, which disappeared after removal of the uterus. (5) A uterus removed post mortem from a case of rupture extending from a traumatic laceration produced by a manual dilatation of the cervix.

These two series of cases have been divided into two groups: (A) Cases of accidental hæmorrhage; (B) Control cases.

In the following description of the macroscopic and microscopic changes, the macroscopic reports of the control cases are omitted, because in these no macroscopic change was observed, except hæmorrhage and œdema along the edge of the rupture.

GROUP A.—CASES OF ACCIDENTAL HÆMORRHAGE.

CASE A 1, S.D. 1170, 1917[1] (CASE 27 OF CLINICAL PAPER).[2]

Macroscopical Examination.

A uterus 16 cm. long by 12 cm. from side to side by 8·5 cm. from before backwards. Its inferior limit is, on the posterior surface, a horizontal line of operative incision 8 cm. long. The rest of the inferior limit is represented by a ragged tear with thinned edge. This tear passes through the lower uterine segment and is horizontal save to the left where there projects downwards a triangular tongue of tissue measuring 7 cm. in length and 3 cm. across its base; the apex of this tongue is part of the cervical lip. There is subperitoneal blood infiltration extending upwards from the edge of the tear for a distance of 5 cm. upon the anterior wall. A similar infiltration is present throughout both broad ligaments and extends inwards beneath the uterine peritoneum of the posterior surface for a distance of 5·5 cm. on the left side, and 4 cm. on the right side. There are faint, irregular subperitoneal hæmorrhages (up to 1 cm. diameter) scattered over the anterior wall of the upper body and over the fundus uteri. The muscularis varies from a thickness of 5 cm. at the fundus to 2·5 cm. at the lower limit. A central vertical section reveals: In the muscularis of the fundus, at a depth of 1 cm. from the peritoneal coat, an irregular hæmorrhagic area, 2·5 cm. long by 0·3 cm. deep; in the anterior wall a hæmorrhagic area 8 cm. from above downwards by 2·5 cm. deep. The latter hæmorrhagic area involves the total depth of the wall save for the outer 2 cm. (and the inner 0·5 cm.); it is slightly raised above the surrounding cut surface and crimson in colour, finely mottled towards its inner margin with translucent grey; it is considerably softer than the surrounding muscularis; it is limited internally by a very definite wavy band of more swollen, less hæmorrhagic, pinkish grey, soft muscularis; 2 cm. above the horizontal tear there is a small, irregular, ill-defined hæmorrhage 0·9 cm. by 0·3 cm. Parallel vertical sections show even more extensive hæmorrhage than in the areas described. The placental site is situated upon the anterior wall; it measures 6 cm. by 5·3 cm. and lies internal to the hæmorrhagic area in the anterior wall. The lower margin of the placental site is 6 cm. above the edge of the tear. The tubes and ovaries are normal. There is a corpus luteum (1·4 cm. by 1 cm.) with glossy fibrous centre (0·6 cm. diameter) in the left ovary.

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[1] The terms S.D. and P.M. and the figures following them refer to the Surgical Department and Post-mortem legend of the London Hospital Pathological Institute.

[2] See *Proceedings*, 1919-20, xiii, p. 178.

A Piece of Liver (5·5 cm. by 3 cm. by 0·8 cm.).—It is clay coloured. The parenchyma is swollen; the lobular pattern distinct. The periphery of each lobule is outlined by a pale brown rim.

Two Portions of Kidney (5·5 cm. by 2·7 cm. by 1·2 cm.).—The capsule is thin, and the stripped surface perfectly smooth. The cortex 0·8 cm. deep, is swollen, clay-coloured and flecked with very small, faint, paler dots. Its cortical pattern is indistinct. The medulla is 1·2 cm. deep.

Microscopical Examination.

Portions were embedded in paraffin and after cutting were stained, with Ehrlich's hæmatoxylin and eosin, with Weigert's iron hæmatoxylin and van Gieson's mixture, and with Weigert's fuchselin and neutral red. Other portions were cut upon the freezing microtome, and sections were stained with Sudan III and hæmatoxylin. Sections (*a*), (*b*) and (*c*) were taken from the anterior wall of the uterus; (*d*) from a small hæmorrhagic area at the fundus; (*e*) from the placental site; (*f*) from an area free from hæmorrhage; (*g*) from the edge of the tear in the uterus; (*h*) from kidney; (*i*) from liver.

Section (a): Anterior Wall of Uterus.—The surface is formed by a narrow zone of decidua vera. Throughout this the cells are dissociated to a greater or less degree and many are shrivelled and devoid of nuclei. This dissociation in places appears to be due to œdema, clear spaces separating the cells; elsewhere the interstices between the cells contain red blood corpuscles. Necrosis is greatest in the areas of hæmorrhage. In the inner sixth of the myometrium the individual muscle fibres cannot be distinguished, but the bundles are represented by a vacuolated matrix in which lie a very few tortuous narrow hyper- and hypochromatic nuclei. The veins are engorged and there are a few areas of hæmorrhage. In the remainder of the inner third a few portions of the muscular bundles show similar degeneration and necrosis. Here, in the majority of the muscle bundles the cells are not shrivelled but are swollen; they are seldom clearly defined, and absence of nuclei is conspicuous. There are many hæmorrhages; these hæmorrhages are for the most part in the fibrous intermuscular septa. The degeneration and necrosis have no fixed relation to the hæmorrhages. In the middle and outer third the changes in the muscle are very similar; defined cells are more numerous but the majority of these are greatly vacuolated; others are hyaline. There are hæmorrhages in the middle and outer third; they are more numerous in the middle third, but here are scanty compared with those in the internal third. In the outer sixth the bundles are widely separated by œdema.

There is an infiltration with leucocytes throughout the decidua, this being greatest where hæmorrhage is absent. There is considerable infiltration throughout the myometrium, chiefly perivascular, lying near veins and capillaries. The majority of the infiltrating cells have a round or oval nucleus and a basophil cytoplasm which is frequently vacuolated; there are also a very few neutrophil leucocytes.

In sections stained with Sudan III, fat granules are demonstrated in the endothelium of a few capillaries and in a very few of the infiltrating cells, but not in the muscle fibres. There is a musculo-elastic hypertrophy of the intima of the larger arteries.

Section (b): Anterior Wall of Uterus.—This section includes the decidua vera. The majority of the muscle bundles in the inner third of the myometrium show degeneration and necrosis similar to those already described. In the central third of the myometrium the fibres in a few bundles are ill-defined and vacuolated or shrivelled, but few have lost their nuclei. In the outer third are very few fibres which are not sharply defined and apparently healthy. There are hæmorrhages in the decidua and several hæmorrhages in the inner third of the myometrium. In the central third there are a few areas of hæmorrhage, and in the outer third are a very few small hæmorrhages. The hæmorrhages are found in areas of degenerate muscle, but there is much muscular degeneration independent of hæmorrhage. In the outer third, greatest in the outer sixth, is an œdematous separation of the muscular bundles. Cellular infiltration similar in character and distribution to that seen in the last section is present. The decidual veins are partly closed by intimal proliferation. Fat is confined to a very few endothelial and free granule-cells.

Section (*c*) : *Anterior Wall of Uterus.*—This section also includes the decidua vera. Muscular degeneration and necrosis are more extensive than in either of the two preceding sections. They, again, increase in amount from without inwards, almost the whole of the inner third of the myometrium being affected. Hæmorrhages are confined to the decidua and inner third of the myometrium. Œdematous separation of muscle bundles is again conspicuous in the outer third. The cellular infiltration is also present. There are numerous polygonal and small, narrow, spindle cells loaded with fat in the interstitial tissue of the inner third of the myometrium ; similar cells are scattered throughout the outer two-thirds. A very few of these spindle cells are of larger size, and may be atrophied muscle fibres.

Section (*d*) : *Fundus of Uterus.*—A portion of myometrium from fundus uteri. In the inner third are extensive necrosis and degeneration of the myometrium together with slight œdema. In the central third the degeneration is slightly less and the œdema is greater. In the inner half of the outer third, separation of the muscle bundles by œdema is very conspicuous, the muscle fibres here are less degenerated but are mostly very narrow, pale and ill-defined. In the outer half of the outer third there is little evidence of œdema or of muscular degeneration. There are a few hæmorrhages into the interstitial tissue of the middle third. In the outer third, in both its outer and inner halves, there are numerous large hæmorrhages. Slight cellular infiltration is again present.

Section (c): Placental Site in Uterus.—In the decidua basalis wide venous spaces are filled by red blood and clot. There is much hæmorrhage into the decidual tissue. In the inner third of the myometrium, degeneration and necrosis of the muscle are extensive. A conspicuous feature is the different degree to which different fibres in one and the same bundle are affected. Thus, there are many bundles in which groups of fibres are swollen, hyaline and nucleated, whilst the remaining fibres are represented by a vacuolated area almost or completely devoid of nuclei (fig. 1). The nuclei in the hyaline fibres are pyknotic. Vacuolated hyaline fibres are also present. In the central and outer third similar degeneration and necrosis are present but are of much less degree. There are no hæmorrhages. Infiltration with neutrophil leucocytes is very great in the decidua and is

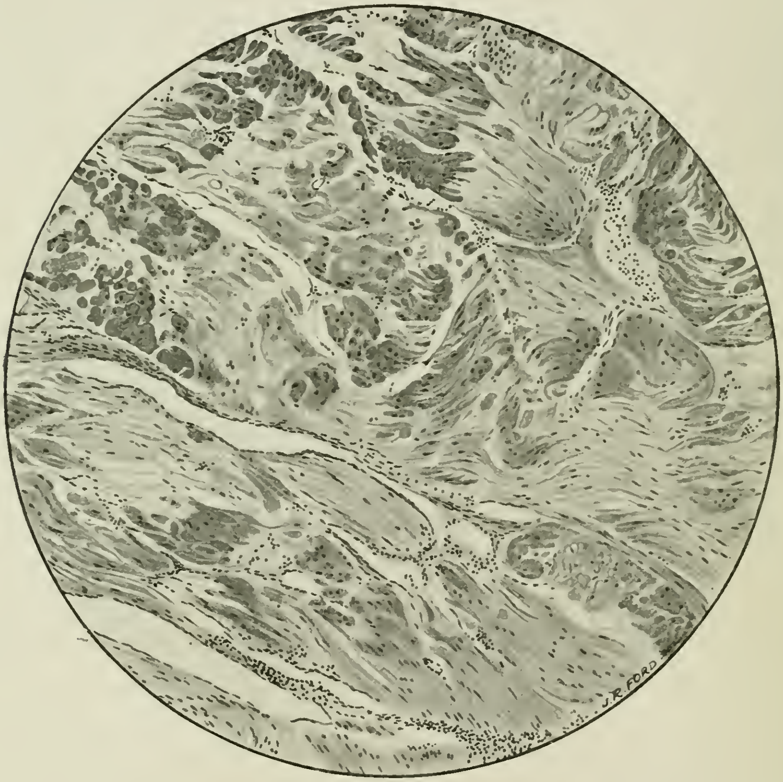

Fig. 1.

Showing extensive focal areas of necrosis and degeneration, with scattered healthy muscle-fibres. Slight perivascular infiltration.

conspicuous in the inner muscularis. Towards the serosa the infiltration decreases, and lymphocytes become much more numerous than leucocytes.

There are many round and polygonal cells loaded with fat in the decidua. In the myometrium there is a considerable number of fat granule cells in the interstitial tissue. Narrow spindle cells containing fat also lie between and parallel to the fibres in many bundles of muscle. In transversely cut muscle bundles the majority of these cells are triangular or stellate and lie between muscle fibres. They belong to the interstitial tissue and some at any rate represent the endothelium of capillaries.

Section (f) : Non-hæmorrhagic Uterus.—In this section degeneration of the myometrium is much less obvious. In many bundles, however, and more especially in portions of bundles, the muscle fibres are greatly vacuolated. The vacuolation is associated with karyolysis. Hyaline degeneration is very rare. The degeneration is slightly greater in the internal and central thirds. There is no hæmorrhage save in the decidua. The decidua is infiltrated with neutrophil leucocytes, lymphocytes, and plasma cells. In the myometrium there is a slight perivascular infiltration with lymphocytes, larger epithelioid cells and plasma cells. The cytoplasm of some of the epithelioid cells is vacuolated.

Section (g) : Edge of Tear in Uterus.—A section taken at right angles to the long axis of the tear. It includes endometrial and peritoneal surfaces for about 2 cm. to the side of the line of cleavage. The decidua drops towards the line of cleavage so that the line of cleavage measures in depth one quarter of the depth of the uterine wall at the other end of the section. For 4 mm. from the line of cleavage the whole wall is represented by a few small islands of degenerate and necrosed muscle, narrow dissociated muscle fibres, and widely dissociated capillaries lying in a sea of blood. In places there are many leucocytes in the hæmorrhage and to a less extent in the fragments of tissue. The hæmorrhage extends beneath the decidua throughout the section, affecting rather less than the inner half of the myometrium. It decreases in extent as it passes from the line of cleavage. As it decreases the fibres in the muscular bundles become less and less dissociated, but there is very little diminution in the degeneration and necrosis of the muscle. In the outer half of the myometrium hæmorrhages are absent; the bundles are separated by œdema; there is very little degeneration of muscle fibres, and necrosis is confined to some of the more internal bundles.

Section (h) : Kidney.—Œdema is indicated by separation of the tubules from one another and from their basement membrane. The cells of the first convoluted tubules and ascending limbs of the loops of Henle vary in size and are frequently ill-defined and vacuolated or fragmented. Numerous nuclei are very faintly stained and shrivelled; pyknotic nuclei are less common; cells without a nucleus are frequent. In many first convoluted tubules the cells are almost completely necrosed. The cells of the second convoluted tubules are fatty and usually dissociated. There are small granules of fat in the epithelium of some of the collecting tubules. In the discharging tubules the cells show perinuclear vacuolation and frequently complete disintegration. There is no cellular infiltration.

Section (i) : Liver.—Small sparse fatty granules are present in the hepatic cells, and are most numerous in those of the centres of the lobules.

CASE A2, S.D. 1135, 1918 (CASE 37 OF CLINICAL PAPER).

Macroscopic Examination.

A uterus amputated through the upper part of the cervix and hardened in formaldehyde. It measures 15 cm. by 10 cm. by 5 cm. The wall is 2 cm. thick at the fundus, and narrows to 1·2 cm. thick at the lower extremity. The peritoneal surface is smooth and pale, save in the following areas. At the lower extremity of the anterior surface is a patch of bright red hæmorrhage (3 cm. diameter) in the subserosa. Around the left cornu the serosa covers a bright red and purple patch (4·5 cm. diameter). On the right cornu is a blue purple area (2 cm. diameter), and a purple area (1 cm. diameter) lies immediately behind the reflection of the right broad ligament near its centre. The inner surface is covered with a velvety, bright red membrane save for an area (12 cm. by 8 cm.) on the posterior aspect; here the surface is ragged and deep red; this is apparently the placental site. The cut surface here is pure white with scattered red specks. The cut surface in the upper part of the anterior wall is, in the inner 1·5 cm., bright red and ragged. An incision through the left cornu passes into the placental site. Here on the cut surface there is, immediately beneath the serosa, a layer 0·5 cm. deep, in which white myometrial strands are separated by wide spaces filled by fluid red blood; subjacent to this is a layer (0·8 cm. deep) of white tissue in which are scattered narrow red lines (0·2 cm. long); internal to this is 1 cm. of hæmorrhagic red tissue. An incision through the right cornu shows some narrow clefts, filled with blood, immediately below the serosa; in the remainder of the cut surface, white bundles are separated by bright red lines. In the fundus, in the centre of the right half, the inner two-fifths of the wall are hæmorrhagic and bright red. In other portions of the wall the cut surface shows small grey areas, separated by white bands, and no red areas. Serial transverse sections show scattered red flecks in the wall beneath the placental site. Other parts show scattered red flecks.

Accompanying specimen is a piece of kidney (6 cm. by 2 cm. by 2 cm.). Cortex almost white, medulla very pale purple. Labyrinths somewhat opaque and white.

Microscopic Examination.

The following portions were taken for microscopic sections: (*a*) Pure white area in anterior wall of uterus; (*b*) hæmorrhagic area in upper part of anterior wall; (*c*) left cornu (placental site); (*d*) hæmorrhagic area in left cornu; (*e*) kidney. The sections were stained by the same methods as in Case A1.

Section (*a*): *Non-hæmorrhagic Anterior Wall of Uterus.*—The decidua consists of a narrow superficial zone of spongy tissue, containing vascular and glandular spaces. There is no cellular degeneration. There is considerable infiltration with lymphocytes and less numerous neutrophil leucocytes, the infiltration being especially periglandular. There are no hæmorrhages and no changes in the walls of the blood spaces.

In a few places in the inner third of the myometrium there are a few red blood cells, immediately outside the vessels. There is widespread but slight perivascular infiltration with lymphocytes, larger mononuclear cells and an occasional neutrophil leucocyte. The infiltration affects the whole wall, but is greatest immediately below the decidua. Certain groups of muscle fibres are narrower than others and are vacuolated. The nuclei in these groups are faintly stained or are absent. These changes are most extensive in the inner quarter. There is intimal proliferation in a few large veins. A section stained with Sudan III shows fine granules of fat filling the cytoplasm of free granule cells in the fibrous tissue. The muscle cells are free.

Section (*b*) *Hæmorrhagic Anterior Wall of Uterus.*—The inner one-sixth is feebly stained and has a homogeneous appearance. No decidua is recognizable. The muscle cells are either shrivelled or swollen, and few contain nuclei. Where the muscle is shrivelled, the interstitial tissue is swollen and is not stained red with van Gieson. There is a little hæmorrhage in this zone. In the subjacent three-sixths there is extensive diffuse hæmorrhage, and also œdematous swelling of trabeculæ. The muscle cells in the inner part of this zone show very similar changes to those just described, but on passing deeper more nuclei are visible, and ultimately there is very little degeneration or necrosis. In the next sixth the muscle bundles are very widely separated by an extreme swelling of the fibrous stroma which is due to impregnation with an albuminous coagulated fluid. The outer sixth appears normal. Leucocytic infiltration is slightly less than in section (*a*). The walls of the arteries and veins in the inner necrotic area are swollen and œdematous; the muscle fibres of the media are shrunken and the majority are without nuclei. Here and in all other sections the changes in the walls of the vessels resemble those in the surrounding tissue, but are, if anything, less severe, not more severe. Fat is limited to free cells in the fibrous stroma. Such fatty cells are few, except in the outermost third.

Section (*c*) *: Left Cornu of Uterus, with Placental Site.*—In the inner fifth, which includes a part of the placental site, there is extensive hæmorrhage throughout the spongiosa. This hæmorrhage is, in places, extreme. Where the hæmorrhage is very great, the tissue is entirely destroyed; where great, the decidual cells, and deeper, the muscle fibres, are separated and extensively necrosed. Where the tissue is less dissected by blood, the muscle fibres are less deeply stained and less sharply defined than in the subjacent two-fifths. There is little loss of nuclei. In the next two-fifths hæmorrhage is considerable but not nearly so extensive as in section (*b*). There is very little evidence of degeneration and necrosis. In nearly the whole of the outer two-fifths there is separation of the muscle bundles by albuminous fluid. This is not seen in the extreme outer part, but here the muscle fibres are feebly stained, ill-defined, often vacuolated and frequently devoid of nuclei. They are less degenerate in the œdematous area. Leucocytic infiltration is greater in the inner two-fifths than in previous sections. In the spongiosa neutrophil leucocytes are numerous, and beneath this plasma cells are present in addition to lymphocytes and occasional leucocytes. In the spongiosa the blood spaces are filled by red clot; beneath this zone several arteries are greatly narrowed by intimal proliferation. Fat is again confined to round and spindle connective tissue cells. These cells are most numerous where the myometrium is least altered.

Section (d): Hæmorrhagic Left Cornu of Uterus.—In the outer zone of longitudinal fibres the myometrium appears normal. Internal to this is a broad zone in which muscle bundles are widely separated by hæmorrhage and œdema. Throughout the remainder of the wall are numerous large focal hæmorrhages. Areas of necrosis occupy large portions of the inner third of the wall. Perivascular leucocytic infiltration is less than in previous sections. There are a few fat granule cells in the interstitial tissue.

Section (e): Kidney.—There is a conspicuous cloudy swelling of the epithelium of the first convoluted tubules. In several of these tubules there is severe dropsical degeneration. There is a little cloudy swelling of the epithelium of the ascending loops of Henle. A multinuclear giant cell is seen in the lining of one convoluted tubule. There is slight fatty degeneration of the epithelium of the second convoluted and collecting tubules. Albuminous casts are present in a few ascending limbs of the loops of Henle, and second convoluted, collecting and discharging tubules. The epithelial lining of the tubules in the medulla is separated by œdema. There is no active inflammatory reaction.

CASE A3, S.D. 189, 1919 (CASE 41 OF CLINICAL PAPER).

Macroscopical Examination.

A uterus amputated through the upper part of the cervix and hardened in Kaiserling No. 1. It measures 17 cm. by 16 cm. by 4·5 cm. There is subserous hæmorrhage about both cornua over an area 4 cm. in diameter. Fainter, purple, smaller areas of subserous hæmorrhage are numerous over the posterior surface and there are a few on the anterior surface. On section, the lining of the posterior wall is grey, granular and nodular: on the anterior wall it is rough, ragged and hæmorrhagic. The wall is 2·4 cm. thick in the upper part, 1·7 cm. thick in the lower part. There are hæmorrhages in the subserosa which extend for a depth of only 1 cm. into the muscularis. The muscularis elsewhere shows white strands enclosing very small, grey areas, and grey, narrow lines. There are also in the muscularis a number of groups, varying in number in different sections, of pinpoint, red flecks; they are most numerous in the upper part of the body and much more numerous anteriorly than posteriorly. In the anterior wall of the body near the mucosa are a few ill-defined red areas up to 0·5 cm. in diameter.

Necropsy.—A complete post-mortem examination was performed on this case. The following is an extract of the findings: "P.M. 78, 1919; anæmia; operation; hysterectomy for internal accidental hæmorrhage; toxæmia of pregnancy. Severe parenchymatous degeneration of liver (14 lb. 13 oz.). Numerous faint, pinhead, opaque, yellow necroses throughout liver especially in right lobe. Anæmia of myocardium and of all organs and tissues. Severe parenchymatous degeneration of kidneys (11 oz.). Slight myeloid transformation of spleen."

Microscopical Examination.

Sections were stained by the methods enumerated above. The following sections were taken from the material obtained by operation: (*a*) from posterior wall of uterus, 2 cm. from lower end including a few pink points; (*b*) from the right cornu, with hæmorrhage extending for 0·8 cm. beneath serosa; (*c*) from anterior wall, 4 cm. from fundus, to show red area near mucosa.

Section (*a*): *Posterior Wall of Uterus.*—The inner surface is covered by a narrow layer of decidua. In large areas of the inner and central thirds of the myometrium the muscle fibres are vacuolated and ill-defined. Where these changes are greatest the bundles in longitudinal section are represented by an almost homogeneous matrix, composed of indistinct parallel wavy fibrils traversed by parallel ill-defined clefts, and furnished with few nuclei. In cross section such bundles are represented by a meshwork of homogeneous cytoplasm containing a few nuclei and enclosing large vacuolar spaces. There is considerable perivascular infiltration with lymphocytes and larger basophil cells throughout the myometrium; in the decidua there is a similar infiltration in which a few leucocytes are present.

Section (*b*): *Right Cornu of Uterus.*—There is very little muscular degeneration. Infiltration of the myometrium is greater and contains a few leucocytes. The muscle bundles in the outer third of the wall are widely separated by œdema, coagulated albumin and blood. In the outer sixth the bundles appear to float in blood.

Section (*c*): *Anterior Wall of Uterus.*—There are many areas of vacuolar degeneration and necrosis of the muscle in the inner third of the myometrium, and one focal area of necrosis in the central third. In the decidua and inner third of the myometrium hæmorrhages are numerous; in the outer third there are two hæmorrhages, and œdema is conspicuous. There is infiltration similar to that in the previous section. There is fat in a few endothelial cells.

The following sections were taken post-mortem: (*d*) From the upper part of the cervix uteri; (*e*) (*f*) and (*g*) from the liver; (*h*) from the kidney; (*i*) from the myocardium; (*k*) from the diaphragm; (*l*) and (*m*) from the spleen.

Section (d): Upper Part of Cervix Uteri.—There are a few muscular bundles in which the individual fibres have fused so as to form a homogeneous matrix in which nuclei are almost completely absent. More numerous are small areas occupied by a widely meshed net of delicate collagen fibrils, enclosing large clear spaces. Many of such areas lie within muscular bundles, groups of muscle fibres lying in their periphery and projecting in places into their centres. They do not, therefore, merely represent œdema of the interstitial tissue, but an œdematous destruction of muscle. Both the above forms of necrosis are found chiefly in the immediate neighbourhood of a large hæmorrhage beneath the mucosa. Isolated areas of œdematous necrosis are found however, at a distance from the hæmorrhage. In the deeper layers of the muscularis and in the submucosa there is a considerable infiltration which contains many neutrophil leucocytes. In the intermediate muscularis infiltration is very slight, and neutrophil leucocytes are rare.

Sections (e) (f) and (g): Liver.—There are grey thrombi in a few large hepatic veins. The cells in the outer third of the lobules are small, dissociated, sharply defined and frequently furnished with two nuclei. In the central two-thirds the cells are swollen, arranged in columns, and can seldom be differentiated from one another; many of their nuclei show karyolysis. Large vacuoles lie in the columns chiefly in their periphery. In sections stained by Sudan III, there is much fat in the cells of the central columns; the dissociated peripheral cells seldom contain fat. Proliferation of interstitial tissue and infiltration of portal systems are absent. The capillaries contain many neutrophil leucocytes.

Section (h): Kidney.—The cells of the first convoluted tubules and the ascending limbs of the loops of Henle are swollen, faintly stained and distinctly granular. In many the nuclei are very faintly stained, in others no nucleus is visible. There is a little fat in the cells of the second convoluted tubules and some of the collecting tubules. The cells lining the discharging tubules show extreme perinuclear vacuolation and frequently complete disintegration. There are hyaline casts in several of the discharging tubules.

Section (i): Myocardium.—There is slight œdema of the interstitial tissue. Cross striation is distinct in the muscle fibres. There is lipochrome in the sarcoplasm at the poles of the nuclei, but the fibres contain no fat. There are many leucocytes in the capillaries.

Section (k): Diaphragm.—There is extensive hæmorrhage into the lipomatous tissue beneath the pleura. There are small areas of infiltration with lymphocytes and epithelioid cells in the peritoneal fibrous tissue. Cross striation is distinct in the muscle.

Sections (l) and (m): Spleen.—The capillary veins are usually narrow. The reticular strands are somewhat swollen, their fibrils are fragmented and many of the nuclei of the cells of the reticulum are very faintly stained or are absent. There are very few free cells in the reticular strands. Such as are present are chiefly plasma cells and eosinophil leucocytes.

In the capillary veins and in the peripheral zones of the Malpighian bodies, there are numerous free cells. The great majority of these are neutrophil leucocytes, many of which have round nuclei. With these is a considerable number of large mononuclear leucocytes and endothelial cells. Eosinophil leucocytes are relatively rare. There are several neutrophil myelocytes, a few normoblasts and one or two eosinophil myelocytes. No megakaryocyte was observed.

GROUP B—CONTROL CASES.

Case B1, S.D. 1198, 1918: Rupture of Uterus due to Obstructed Labour.

Microscopic Examination.

Section (a): Posterior Wall of Uterus, above Tear.—There is considerable patchy infiltration containing many neutrophil leucocytes in the decidua, and very slight perivascular infiltration in the myometrium. There are no hæmorrhages and there is no œdema in the myometrium. The muscle fibres are large and sharply defined (fig. 2). The only evidence of degeneration is a vacuolation which is seen in a few fibres, especially in bundles cut transversely. The lumina of the veins and of several arteries are narrowed by a proliferation of the fibrous, elastic and muscular elements of the intima. In sections stained with Sudan III, there are a few small granules of fat in a very few spindle and round cells in the interstitial tissue about vessels.

Sections (b) and (c): At Right Angles to Tear in Upper Uterine Segment.—In both sections the torn edge is only about one-third the length of the total thickness of the uterine wall, the decidual surface curving outwards towards the line of cleavage. The tear follows the course of large fibrous intermuscular septa, and in (b) has opened a large vein. Thus, the uterine wall, before rupture, appears to have thinned at a point where the interstitial tissue was relatively abundant and the muscularis relatively scanty. There is hæmorrhage in the decidua, in intermuscular septa and in the subserosa for a moderate distance from the line of cleavage. In many of the muscular bundles, actually isolated by the hæmorrhage, the fibres are pale and ill-defined whilst their nuclei are shrunken or absent. These bundles are infiltrated with numerous leucocytes. Apart from a slight interstitial œdema, the remainder of the myometrium resembles that in section (*a*). In sections stained by Sudan III, fat is only found in a very few interstitial cells. The muscular necrosis in these sections is closely associated with the hæmorrhage in the margin of the line of cleavage and appears to be secondary thereto.

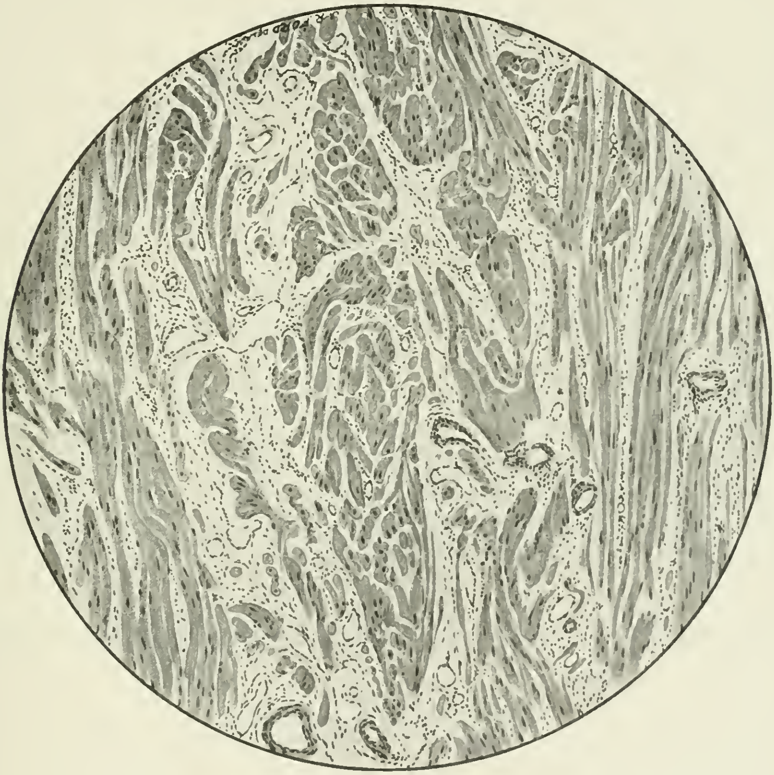

FIG. 2.

Healthy muscle-bundles; slight perivascular infiltration.

Section (d): At Right Angles to Tear in Lower Uterine Segment.—The line of cleavage is only slightly shorter than the total depth of the wall, the mucosa curving out for but a short distance. The line of cleavage is remarkably straight. Leucocytic infiltration is present throughout, and is greatest at and near the line of cleavage. There is extreme œdema of the inner three-fifths of the myometrium throughout the section. External to this, the œdema is relatively slight. Extensive hæmorrhages are present throughout and are more abundant towards the limit of the section furthest (2 cm.) from the line of cleavage than in the margin of the line of cleavage. They are most abundant in the inner, extremely œdematous, zone. The muscle fibres in the inner three-fifths of the myometrium are widely separated by the œdema and are represented by sinuous threads; loss of nuclei is not appreciable. In sections stained with Sudan III, fat granules are present in a few interstitial cells, and at the poles of the nuclei of some of the attenuated muscle fibres.

The abnormalities in this section are not confined to the margin of the tear nor are they focal in the remainder of the tissue. They are evenly distributed throughout. Compared with the cervix removed post mortem in the third case of accidental hæmorrhage (pp. 172, 173) the abnormalities are much more general and diffuse. In the case of accidental hæmorrhage there were focal areas of œdema in which the muscle bundles had almost entirely disappeared. In this case there is almost universal dissociation of the muscle fibres by œdema with little evidence of necrosis.

CASE B2, S.D. 732, 1919: RUPTURE OF UTERUS IN OBSTRUCTED LABOUR.

Microscopic Examination.

Section (a): Edge of the Laceration in the Lower Uterine Segment.—There is hæmorrhage on, in, and in a few places, at a little distance from, the line of fission. The muscle bundles throughout are separated by œdema and there is a little cellular infiltration of the interstitial tissues similar to that in preceding cases. There are a few small hæmorrhagic areas in the decidua at a distance from the line of cleavage. The fibres of the myometrium appear almost without exception to be longer and more sharply defined than in the previous case. Within the areas of hæmorrhage the fibres, in some of the bundles, are ill-defined and are occasionally slightly vacuolated. There appears also to be some loss of nuclei. Nowhere, however, are there the conspicuous degenerations and necroses which were widely distributed throughout the myometrium in the cases of accidental hæmorrhage.

Section (b) : Edge of the Laceration in Dilated Lower Uterine Segment.—The line of cleavage is less than two-thirds of the depth of the uterine wall, the decidua and subjacent myometrium curving out towards the line of cleavage. At, and for some distance from, the edge of the laceration hæmorrhages are numerous throughout the myometrium. In the subserosa great hæmorrhage extends for a long distance from the edge of the rupture. There are very numerous hæmorrhages in the submucosa and subjacent myometrium to a depth rather less than the inner half of the wall. External to this there are scattered small hæmorrhagic areas. There is great œdema throughout. Perivascular infiltration containing many neutrophil leucocytes is also present throughout. For a considerable distance from the edge of the rupture the muscle fibres are represented by widely separated, very narrow, often sinuous fibrils containing spindle nuclei. Throughout the remainder of the wall most of the muscularis has undergone a similar change. Bundles of stout fibres are present however in the outer half of the wall and occasional bundles showing only slight dissociation are present at the sides of some of the larger vessels. In the more solid bundles a considerable number of the fibres have undergone hyaline degeneration and there is a deficiency of nuclei. The changes in the cervix resemble those in Case B1, and differ in the same manner from those in the cervix in Case A3 of accidental hæmorrhage.

CASE B3, S.D. 1277B, 1919: PLACENTA PRÆVIA AND INTRA-UTERINE HÆMORRHAGE.

Microscopic Examination.

Section of Wall of Upper Uterine Segment.—There is considerable infiltration of the decidua; among the infiltrating cells is a moderate number of leucocytes. In the remainder of the wall there is a slight perivascular infiltration in which leucocytes are scanty. Compared with the cases of accidental hæmorrhage the muscle fibres are stout and show very little variation in size and, excepting a narrow zone immediately beneath the mucosa, they are much more sharply differentiated. A vacuolar degeneration of different type is present. In the transversely cut bundles of the subserous zone perinuclear vacuolation is very conspicuous; many bundles appear to be almost entirely composed of a mosaic of rounded spaces containing central nuclei. Occasional fibres showing a similar vacuolation but usually of less degree, are seen throughout the rest of the myometrium.

CASE B4, S.D. 1419, 1917: RUPTURE OF UTERUS, SLIGHT OBSTRUCTION, ALBUMINURIA.

Microscopic Examination.

Sections (a) and (b): Placental Site on Anterior Wall of Uterus.—Vacuolation, loss of definition, and loss of nuclei is very widely spread throughout the inner half of the myometrium. They are less in degree and distribution in the outer half. There are no hæmorrhages. There is considerable œdema of the outer half of the myometrium. In sections stained by Sudan III, there are fat granules in a very few interstitial cells in the outer half of the myometrium.

Sections (c) and (d): Posterior Wall of Uterus.—Resemble sections (*a*) and (*b*) save that in the outer longitudinal layer the muscle fibres are shrunken and vacuolated.

Section (e): Lower Uterine Segment at Right Angles to Serous and Subserous Prolongation of Tear.—The uterine wall tapers towards the lower or cervical end. Vacuolation and loss of differentiation of the muscle fibres is present throughout the inner half of the myometrium. In the outer half, in the margins of the tear, the bundles are isolated by hæmorrhage; the fibres show similar changes, or are hyaline, and there is extensive loss of nuclei. On both sides of the tear there is great œdema of the outer half of the myometrium. On the uterine side the muscular bundles are separated by the œdema and there is conspicuous karyolysis. On the cervical side the fibres in the bundles are dissociated and are seen as sinuous threads usually furnished with nuclei. On this side there are hæmorrhage and great infiltration with leucocytes. In sections stained with Sudan III fat is present not only in interstitial cells but at the poles of the nuclei of a few attenuated muscle fibres.

CASE B5, S.D. 930, 1919: RUPTURE OF UTERUS PRODUCED BY MANUAL DILATATION OF CERVIX.

Microscopic Examination.

Section (*a*) *: Uterine Wall at Placental Site.*—There is a slight dissociation of the muscle fibres as seen in specimens kept for some time before fixation. The muscle fibres in the inner sixth of the myometrium are less deeply stained, and in general slightly smaller than those in the outer five-sixths. In this inner zone the fibres in longitudinal section are frequently split by narrow longitudinal clefts, and the individual fibres cannot be differentiated. There are no hæmorrhages. There is an infiltration similar to that in all previous cases. In sections stained with Sudan III granules of fat are present in a considerable number of cells of the interstitial tissue, chiefly in spindle cells.

Section (*b*) *: Uterine Wall opposite Placental Site.*—In the inner quarter of the myometrium the fibres show a slightly greater degree of the degeneration present in the inner sixth of section (*a*). In a few fibres the nuclei are shrunken, or are only just recognizable; a few fibres are without nuclei.

SUMMARY AND COMPARISON OF MICROSCOPIC FINDINGS.

In the uterine wall of the three cases of accidental hæmorrhage, the following histological changes were found : An infiltration of the decidua with cells, among which neutrophil leucocytes were numerous ; a slight perivascular infiltration of the myometrium, which decreased in amount from within outwards, and in which leucocytes were scanty ; a conspicuous leucocytic infiltration in the margins of the rupture (Case A1) ; fat granules in occasional interstitial cells and endothelial cells, and, in A1, apparently also in degenerate muscle fibres ; a conspicuous œdema, usually albuminous, in the outer part of the myometrium ; widespread, conspicuous, focal areas of degeneration and necrosis in the myometrium of the upper uterine segment, especially in its inner half : widely spread areas of hæmorrhage in the myometrium of the upper uterine segment ; an absence of invariable coincidence between the areas of necrosis and of hæmorrhage, so that the necrosis could not be considered to be secondary to the hæmorrhage ; in A3, in which examination was made of the lower uterine segment, a large focal area of necrosis, hæmorrhage and œdema in the inner portion of the myometrium.

In the uterine wall of the five cases taken as controls, the following changes which had been found in the three cases of accidental hæmorrhage were again found in all cases: the cellular infiltration of the decidua and myometrium; the conspicuous leucocytic infiltration in the margins of ruptures: fat granules in occasional interstitial cells and endothelial cells, throughout the myometrium.

In B1, a case of rupture of the uterus in obstructed labour, and in B4, rupture of the uterus following trivial obstruction to labour, fatty granules were also found at the poles of the nuclei of a few muscle fibres in the neighbourhood of the ruptures.

In other respects the control cases differed from those of accidental hæmorrhage. Œdema in the upper uterine segment of the control cases was confined to the neighbourhood of ruptures, but was found throughout such sections as were taken of the stretched lower uterine segment. (Cases B1, B2, rupture of uterus due to obstruction; and B4, rupture of uterus associated with trivial obstruction.)

In B1, a case of rupture of the uterus due to obstructed labour, necrosis was confined to muscle fibres enclosed within the hæmorrhage at the margin of the rupture. The muscle fibres in the lower uterine segment were greatly elongated and attenuated, but necrosis was not observed. In the upper uterine segment, the margin of the rupture being excluded, the only evidence of degeneration was vacuolation of a few muscular fibres. In B2, the second case of rupture due to obstruction, sections were taken from the lower uterine segment alone, including the rupture. There were, again, degeneration and some necrosis of fibres included within areas of hæmorrhage, and great elongation and attenuation of the muscle fibres throughout. In B3, the case of distension of the uterus by hæmorrhage due to a placenta prævia, the upper uterine segment was alone examined; degeneration was confined to a perinuclear vacuolation of the fibres in the longitudinal layer of muscle beneath the serosa. In B4, the case of rupture of the uterus with trivial obstruction, widely spread degeneration and necrosis of the muscle were present in the inner half of the myometrium of the upper and lower segments. This necrosis was less severe than in the cases of accidental hæmorrhage. In the lower segment there was also the attenuation of muscle fibres seen in B1 and B2. In B5, the case of rupture of the uterus during manual dilatation of the cervix, degeneration and necrosis were again present in the inner portion of the myometrium in both portions of the upper segment examined. The necrosis was less severe than in B4.

Hæmorrhage in the upper uterine segments of the control cases was confined to the margin of a rupture (B1). In the lower uterine segment hæmorrhage was found in the margin of ruptures (Cases B1, B2 and B4), and a diffuse hæmorrhage was also found in the two cases in which the rupture was due to gross obstruction (B1 and B2).

Where in the upper segment of the control cases there were both hæmorrhages and necroses, the necroses were found within areas of hæmorrhage at the margins of ruptures: but necrosis appeared to be the result of isolation of muscular bundles by hæmorrhage.

Comparison of the cases of accidental hæmorrhage (A) with the control cases (B) shows, therefore, that certain changes were present in all the uteri examined. These changes were: Infiltration of the decidua with cells, among which neutrophil leucocytes were numerous; a perivascular infiltration throughout the myometrium which decreased in amount from within outwards and in which leucocytes were scanty; fat granules in a few cells of the interstitial tissue, in a few endothelial cells and in a very few muscular fibres.

Inasmuch as these changes were present not only in the cases of accidental hæmorrhage but in all the examples of various conditions taken as controls, they appear to be changes common to all uteri about full time. They are certainly not peculiar to cases of accidental hæmorrhage.

Further, hæmorrhage and a conspicuous leucocytic infiltration were present in the margins of all ruptures, not only in the case of accidental hæmorrhage but in the control cases.

This hæmorrhage and leucocytic infiltration can only be considered to be the result of rupture.

In the cases of accidental hæmorrhages focal hæmorrhage was widespread throughout the myometrium of the upper uterine segment. In the control cases there was no hæmorrhage in the myometrium of the upper uterine segment, except in the margins of ruptures. In the lower uterine segment, however, of two of the control cases (B1 and B2) diffuse hæmorrhage was associated with attenuation and elongation of the muscular fibres. The two control cases were cases of rupture of the uterus due to obstruction to labour.

Diffuse hæmorrhage was found, therefore, in the stretched, lower uterine segment of the two cases of obstruction to labour. There can be little doubt that these hæmorrhages were the direct result of mechanical stretching of the lower uterine segment. The upper segment of these uteri was doubtless protected from stretching and consequent hæmorrhage by active contraction and retraction. These observations suggest that the hæmorrhages in the upper segment of the three cases of accidental hæmorrhage may have been due to stretching, by internal hæmorrhage, of upper segments which were not protected by active contraction. This conclusion is excluded, however, first by the absence of microscopic evidence of stretching of the muscular fibres, and secondly by the Control Case B3. In Case B3 there was, owing to separation of a placenta prævia during the bringing down of a leg, a greater distension of the uterus, by internal hæmorrhage, than in any of the cases of accidental hæmorrhage. Further, contraction and retraction of the upper segment in this case were excluded, the uterus being in a state of atony produced by chloroform. Yet, in this case, B3, there was no hæmorrhage in the upper uterine segment.

It can be concluded, therefore, that diffuse hæmorrhage in the lower segment of the cases of obstructed labour was due to mechanical stretching, but the widespread hæmorrhage in the upper uterine segment of the cases of accidental hæmorrhage cannot be ascribed to a similar mechanical cause.

For similar reasons the great œdema, for the most part albuminous, which was present in the outer zones of the myometrium throughout the uteri in the cases of accidental hæmorrhage cannot be ascribed to mechanical stretching, although great œdema was present in the stretched lower segment of the control cases B1 and B2 in which the uterus ruptured owing to definite obstruction to labour, and B4 in which the uterus ruptured in the presence of trivial obstruction to labour. Neither can the œdema found in the cases of accidental hæmorrhage be considered of similar origin to that found in the upper uterine segment of control cases. In the control cases it was only found in the margins of ruptures; in the cases of accidental hæmorrhage it was present in all sections, including those of the two cases in which there was no rupture.

The following changes were, therefore, peculiar to the cases of accidental hæmorrhage: A severe œdema and a widespread focal hæmorrhage in the myometrium which were independent of stretching and of rupture.

Finally, in all three cases of accidental hæmorrhage focal areas of degeneration and necrosis were widespread throughout the myometrium, especially in the inner zones. This degeneration and necrosis were associated with hæmorrhage, but they were not due to the hæmorrhages because they did not occur invariably in areas in which hæmorrhage was present. They differed, therefore, from the degeneration and necrosis found in control cases within the hæmorrhages at the borders of ruptures. The degenerations and necroses were even more conspicuous than the widespread hæmorrhage and œdema which have been shown to be peculiar to the cases of accidental hæmorrhage. But these degenerations and necroses were not peculiar to the cases of accidental hæmorrhage. They were found in less degree in Case B4, in which rupture of the uterus was associated with trivial obstruction, and in still less degree in Case B5, in which the uterus ruptured during manual dilatation. On the other hand, they were not found in the two cases of rupture due to obstructed labour (B1 and B2), nor in the case of distension of the uterus by hæmorrhage in placenta prævia (B3).

From comparison of the conditions within all the uteri examined and of the mechanical conditions to which these uteri were exposed, it is not possible to find an explanation of the incidence of these necroses. An explanation may be found when other features in the cases are taken into consideration.

In all three cases of accidental hæmorrhage, toxæmia was indicated by the presence of albuminuria during life, and was proved by such histological examinations of the kidney and liver as were made; that is, of the kidney in all three cases and of the liver in two cases. In the kidneys there was a severe albuminous and a slight fatty degeneration. In one liver there was a conspicuous fatty degeneration; in the other there was fatty degeneration in the centres of the lobules, whilst in the periphery of the lobules there were changes indicating a slow destruction and regeneration of parenchyma.

In the Control Case B4 there was also evidence of a toxæmia of pregnancy; a severe albuminuria was present, and disappeared soon after the removal of the ovum and uterus.

In the absence of any other explanation of the degeneration and necrosis in the myometrium of the three cases of accidental hæmorrhage and of Case B4, the fact that they were associated with a toxic degeneration of other organs leaves little doubt that the changes in the myometrium were the result of a toxæmia of pregnancy. The absence of evidence of toxic degeneration of the kidney as shown by albuminuria, in Case B5, does not nullify this conclusion. The degeneration and necrosis in Case B5 were of less degree than in the other four cases. They may well have been due to a toxæmia of slighter intensity.

The degeneration and necrosis of the myometrium evidently renders the uterus liable to rupture. In one of the three cases of accidental hæmorrhage, the uterus ruptured in the absence of any abnormal obstruction to labour. In Case B4 the uterus ruptured in the presence of an obstruction insufficient to cause rupture of a normal uterus. It is possible that the uterus in Case B5 ruptured under a strain which a normal uterus would have withstood; unfortunately no information could be obtained concerning the strain to which the uterus was subjected by the manual dilatation.

To Professor Hubert Turnbull my sincerest thanks are due for kindly help and encouragement. He has devoted much of his valuable time to controlling my work, and it is with his complete accord that this paper is now published.

CONCLUSIONS.

(1) The changes characteristic of, and peculiar to, cases of accidental hæmorrhage are widespread necrosis, hæmorrhage and œdema in the myometrium.

(2) These changes are not due to mechanical injury.

(3) The necrosis is closely associated with the hæmorrhages but is not due to the hæmorrhages. The necrosis, hæmorrhage and œdema are due to the same cause.

(4) The cause is a toxæmia of pregnancy, which damages the kidneys and liver as well as the uterus.

(5) A less degree of this toxæmia can cause necrosis of the myometrium without hæmorrhage and œdema (Case B4).

(6) A still less degree can cause a slight degree of necrosis without hæmorrhage and œdema, and without an albuminuria giving evidence of poisoning of the kidney (Case B5).

(7) The necrosis of the myometrium renders the uterus liable to rupture.

(8) In the uteri affected by this necrosis evidence of fatty degeneration is extremely slight, and is no greater than that in normal uteri at full time.

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DISCUSSION.

Dr. Eden: The paper is a valuable one and forms a real contribution to our knowledge. Mr. Ley has made out an unanswerable case for the toxic origin of the lesion he describes in the uterine wall, and this must be considered together with the other clinical and pathological evidences of toxæmia, such as albuminuric and post-mortem changes in the liver and kidneys. It therefore appears to me that we can now distinguish three types of pregnancy toxæmias—one associated with pernicious vomiting, one with eclampsia and one with accidental hæmorrhage. The clinical features are widely divergent, and it can hardly be thought that the toxins are the same in each type. It is clear that evidences of toxæmia can be found before hæmorrhage becomes a clinical feature of the case, and will Mr. Gordon Ley therefore tell us what he thinks is the sequence of events which leads up to the hæmorrhage?

Dr. HERBERT SPENCER: Mr. Gordon Ley has made a very valuable contribution to our knowledge in his detailed descriptions and demonstration of the conditions found in his three cases. But the original title of his paper is too wide. His own investigations deal only with three cases of accidental hæmorrhage, *which were all associated with albuminuria.* It is well known that a large proportion of cases of accidental hæmorrhage are free from albuminuria; that in those which are albuminuric the amount is often small, and that even the severest cases may be entirely free from albumin.[1] The literature of the pathological changes found in the uteri of toxæmic puerperæ and also in those in whom there is no evidence of toxæmia is very extensive. It seems premature to give the title "The Pathology of Accidental Hæmorrhage" to a paper of which all the cases personally investigated by the author showed evidence of toxæmia, including albuminuria. Further investigation will be necessary before the whole subject of the pathology of this interesting condition can be written.

Mr. HENRY BRIGGS (Liverpool): I ought to allude to the results of a recent research in the University Obstetrical Laboratory by a Liverpool graduate, Dr. Gordon Roberts. In an analysis of thirty-two cases of severe accidental hæmorrhage (maternal death-rate 6·08 per cent.; fœtal death-rate 94 per cent.) thirty-one were in the ninth month of pregnancy or at full term. In only 28·6 per cent. was there albuminuria; hence, as a direct cause of accidental hæmorrhage, the ordinary toxæmia of pregnancy is apparently almost ruled out. It is remarkable that the improved results in the management of the labour have been due to the treatment of the hæmorrhage. Goodell, a pioneer, in 104 cases reported fifty-four maternal deaths. Braxton Hicks in twenty-three, thirteen maternal deaths. The toxæmia, as Dr. Eden suggests, may be of a special kind; the ordinary toxæmia of pregnancy has not been correspondingly lessened in risk. The local effects of hæmorrhage and œdema, acute or not acute, must not be overlooked. Mr. Gordon Ley's careful and searching investigation will be followed by others.

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[1] E.g., *see* P. Zweifel (*Monatsschr. f. Geb. u. Gynäkol.*, 1912, xxxvi (Ergänzh.), p. 63). Of twenty-one cases of accidental hæmorrhage, thirteen were free from albumin, three showed only traces, five showed clear evidence of albumin, but only three (of the twenty-one) in large amount. On p. 55 (loc. cit.) are given particulars of a severe case of accidental hæmorrhage which terminated fatally and in which post-mortem examination showed the placental site at the posterior wall of the fundus. The urine was free from albumin.

Mr. Gordon Ley: Dr. Eden has asked me what actually produces the accidental hæmorrhage. I think the sequence of events is as follows: (*a*) Necrosis of muscle; (*b*) consequent hæmorrhage; (*c*) tracking of the blood through the decidua separating an area of the placenta; (*d*) opening up of uterine sinuses; (*e*) the hæmorrhage. Mr. Briggs misunderstands me if he thinks that I suggest that accidental hæmorrhage should be treated by treating the toxæmia. The treatment of accidental hæmorrhage was fully discussed in the paper read at the March meeting,[1] and I do not wish to alter my observations made then in any way. I do consider, however, that accidental hæmorrhage may be prevented by the recognition and treatment of toxæmia of pregnancy. It was pointed out that I have only given a pathological record of three cases and that the pathology of all accidental hæmorrhage is not necessarily the pathology that I have given. The only cases which I have not found to be associated with albuminuria are the mild cases and in these cases it is impossible to get pathological material. I shall be only too pleased to carry out further pathological work if material is provided. In my own fifty cases, 84 per cent. were associated with albuminuria, and I consider that the smaller percentages recorded by other people are due to the inclusion of cases of lateral placenta prævia with the accidental hæmorrhage figures.

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[1] See *Proceedings*, 1920, xiii, pp. 163-185.

Section of Obstetrics and Gynæcology.

President—Mr. Henry Briggs, F.R.C.S.

Spoon-shaped Depressed Birth-fracture of the Right Frontal Bone treated by Elevation.[1]

By Henry Briggs, F.R.C.S.

The President, Professor Briggs, in a short communication with lantern illustrations of the condition before and after operation, alluded to the great rarity of the uncomplicated, i.e., the purely localized, head injuries and deformities suitable for surgical treatment. In a conspicuous instance, he had recently been associated with Dr. W. McIntyre Brown and Mr. Craig Dun, whose reports he would read :—

Obstetrical History, by W. McIntyre Brown, M.D.

A healthy mother, aged 41. Two previous instrumental labours : (1) Female child, 7 lb. ; (2) Female child, $6\frac{3}{4}$ lb. The third labour at full term was protracted ; the head did not descend through the brim during a whole day's waiting under morphia and afterwards under scopolamine ($\frac{1}{450}$ gr.) every hour and a half. In the R.O.A. position the fœtal head, obliquely gripped by the axis traction forceps, under gently increased traction, suddenly, with a perceptible hitch and a jerk, passed through the brim of the pelvis. The large female child, 9 lb., breathed freely ; the deformity of the depressed fracture was unsightly, but symptomless ; consultation and operation were advised ; the result is excellent.

Elevation of the Bone, by R. Craig Dun, F.R.C.S.

Baby H., when seen by me on the seventh day after instrumental delivery, showed a spoon-shaped depressed fracture of the right frontal bone $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in., and $\frac{1}{2}$ in. deep. There were no signs of cerebral pressure or irritation ; the bulk of the depression was below the hair level and produced a most unsightly deformity. My suggestion was to watch the case for a fortnight and, should no spontaneous elevation occur during that time, to then elevate by operation.

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[1] At a meeting of the Section, held October 7, 1920.

Fourteen days after first seeing the child there was no change in the depression, so, at the age of 3 weeks, the operation was performed. Under ether two half-inch incisions were made in the upper part of the frontal bone, on either side of the depression, so that both lay in the hair-covered area. The incisions passed through the scalp and the thin membranous bone, which was easily cut with the knife. By means of two flat-bladed periosteal detachers, slightly curved upwards towards their ends, and inserted simultaneously through the incisions, the depressed bone was levered up. The small skin incisions were closed with a few horse-hair sutures.

There was no shock after the operation, nor any signs of cerebral disturbance. Healing of the incisions occurred normally. The result is most satisfactory, the appearance of the child being greatly improved. The two sides of the forehead are now practically symmetrical.

I have now operated on four cases of depressed birth fracture of the skull ; two in the parietal, and two in the frontal region. In all the results have been satisfactory, and I consider that operation is a safe and sound procedure in this condition. It is wise to delay operating for three or four weeks after birth, in order to watch for any signs of spontaneous elevation—this I have seen occur in cases of slight depression. Delay beyond this period serves no useful purpose, and certainly increases the difficulty of elevation by operation.

Mr. CLIFFORD WHITE said he thought the method of treatment adopted in the President's case was open to criticism. Such cases could be divided into two classes, those in which the depression in the bone was the only lesion, and those in which there were hæmorrhages below the dura and perhaps also brain injury as well. An uncomplicated case tended to get right during the growth of the head and, except in very severe cases, no operation was necessary. In the second class of case, operation was indicated, as such infants tended to die soon after birth and often did not breathe well from the beginning. He also believed that it was held by neurologists that certain cases of diplegia and impaired intelligence were the result of cerebral injuries at birth and so, if such infants recovered, their future was of uncertain value. If this were so, the serious after-effects would not be prevented by blindly levering up the bone through a small hole, but only by treating the more serious subdural hæmorrhage on the accepted lines of surgery. If an operation were done, it should be by turning down a scalp flap and then a smaller skull flap to include the depressed area. In this way the dura could be inspected and, if a subdural hæmorrhage were found, it could be evacuated and the flaps replaced. He had done this on two occasions on babies within a few hours of birth—both recovered without complications. It was not difficult to do; the position of the temporal artery should be borne in mind in making the big scalp flap, and the longitudinal sinus avoided, if possible, in opening the skull. In one case in which a large subdural hæmorrhage was evacuated in this way, he had been fortunate in having the child under observation for six years and found that the age of crawling, speaking, walking, &c., was not delayed. The child was now of full average intelligence and size. Methods depending on pulling out the skull dent with hooks or a volsellum, inserted through a prick in the scalp, or pushing out the dent by curved instruments inserted blindly through small incisions, would fail in cases in which operation was most needed—i.e., cases with subdural lesions. Such methods were comparable to tapping an ovarian cyst through the abdominal wall instead of performing ovariotomy.

The Surgery of the Uterus Bicornis Unicollis, with a Case of Resection of Uterus followed by Two Normal Pregnancies.

By J. M. Munro Kerr, M.D.

The uterus bicornis unicollis is a fairly common malformation, and frequently causes a good deal of disturbance to both gravid and non-gravid. The condition has often been referred to at this Section, more particularly the variety in which the two halves are asymmetrical—the so-called uterus bicornis cum cornu rudimentario. Interesting cases of this kind have been described in which the rudimentary horn has ruptured, and one or two in which pregnancy followed after removal of the ruptured horn.

Pregnancy in Rudimentary Horn-rupture.—Mrs. S. was admitted to my wards in the Royal Infirmary on June 6, 1918, in a collapsed condition. Menstruation had always been normal, and was of the twenty-eight-day type. She had been married for three weeks, but on questioning her she admitted that she had not menstruated for three months. Twenty-four hours before admission she was seized with acute abdominal pain and sickness. I operated upon her within a few hours of her admission, having diagnosed extra-uterine pregnancy from the clinical history. The condition proved to be a ruptured rudimentary horn. This, along with the fœtus and placenta, was removed, and the stump covered with peritoneum. The normal half with tube and ovary were conserved.

Reference has also been made occasionally to the dysmenorrhœa associated with this type of malformation, especially where one half is rudimentary, but so far I am unaware of any case quite similar to the one now to be described. In this case the dysmenorrhœa was so extreme that a gynæcologist advised oöphorectomy, but I succeeded in almost completely relieving this dysmenorrhœa by removing the rudimentary half. Further, the woman became pregnant some years after and gave birth to a child a little before term.

Uterus Bicornis Unicollis Asymmetricus (Rudimentary Horn) with Extreme Dysmenorrhœa: Removal of Rudimentary Horn with relief of Dysmenorrhœa; Pregnancy Some Years Later; Parturition at Eighth Month.—This patient, an unmarried woman, aged 20, was brought to me by her mother on account of most extreme dysmenorrhœa. The pain came on the first day of the period and lasted for about twenty-four hours. She informed me that a gynæcologist had removed one ovary two years before because it was slightly cystic, and that he had found that the uterus was of the nature described above, the left half being rudimentary. He now suggested removing the other ovary. After examination under an anæsthetic I confirmed these facts, and that there was a communicating canal from the cervix. But I explained that removal of the ovary was not the ideal course, and that I would suggest removal of the rudimentary horn, as in all probability it was responsible for the dysmenorrhœa. This I did some days later. After removing it, I covered up the wall with cellular tissue and peritoneum. Some years later she married, and within a few months fell pregnant. The pregnancy had a normal course until the later weeks when albumin developed. I was very anxious about the case because I feared the uterus might rupture. She was placed, therefore, in a nursing home for the later weeks of her pregnancy and her confinement. The labour came on about four weeks before term, and the child presented by a breech. At first it looked as if Cæsarean section might be necessary, because the cervix was drawn up to the left. In time, however, dilatation and satisfactory descent of the breech occurred, and ultimately a living male child was delivered without much difficulty. The patient's recovery was delayed by albumin which persisted for several weeks.

But to-night I am not so much concerned with this type of malformation as with the variety in which the two halves are symmetrical. I wish to draw attention to the plastic operation for this condition which has been performed in a few cases, and to record a most satisfactory case of my own in which the uterus was resected some years ago, and in which two pregnancies have occurred since. The following is the history of the case:—

Uterus Bicornis Unicollis (Symmetricus) ; Resection of Uterus ; Two normal Pregnancies.—I saw this patient with Dr. Miller, of Shettleston, when she was two and half months pregnant. She was aged, at that time, 32, and had been married nearly a year. Dr. Miller informed me that he felt a tumour to the right of the uterus, but he had difficulty in deciding between a myoma complicating a uterine pregnancy, a pregnancy in a double uterus, and an extra-uterine pregnancy. By the time I saw her, however, the diagnosis was less difficult, because the cervix was dilated and the ovum could be felt through the dilated cervix. We could therefore exclude the third possibility—viz., ectopic pregnancy. I could not, however, decide between the first two. She was sent into the Maternity Hospital, and after removal of the ovum I carefully examined the condition and found we had to deal with a uterus bicornis unicollis in which pregnancy had developed in the right half. She made a satisfactory recovery. Some nine months later Dr. Miller sent her into my wards in the Royal Infirmary suffering from a second abortion, and again in the right half. When she recovered from the second curettage I explained to her the exact condition, and told her I thought I could improve matters, and that with her permission I would resect the uterus. I thought this was quite possible because I had examined the uterus very carefully under anæsthesia between the two abortions and found that the two halves were symmetrical. She willingly consented, and I excised a portion out of each half, and carefully stitched the two halves together. She fell pregnant nine months later. During the later months of the pregnancy she resided in my wards in the Royal Infirmary, and later, when labour started, which it did at term, she was transferred to the Maternity Hospital. I watched her very carefully during the first stage, which lasted about eighteen hours. I allowed the second stage to go on for two and half hours, and then, being afraid that rupture might occur, I thought it advisable to deliver her with forceps. The pelvis was flattened and the head lay transversely in the cavity. I experienced much greater difficulty in the delivery than I had expected, and unfortunately did considerable injury to the child. After the delivery of the placenta I passed my gloved hand into the uterus to determine the condition of the cicatrix. I found the placenta had been situated in the posterior wall. What was of special interest and satisfaction, however, was the fact that I could feel a longitudinal ridge running vertically along the anterior and posterior uterine wall.

The child was born alive but asphyxiated. It seemed to make satisfactory progress, but ultimately died on the twelfth day of convulsion, the result of the cranial injuries. She is at present again pregnant and expects her confinement in September when I intend to deliver her by Cæsarean section.

The first case of this kind was recorded by Truzzi. Next are two recorded by Strassmann[1]; another by Fräenkel.[2]

I performed the operation because the patient had had two miscarriages. This occurrence seems to be fairly frequent, to judge by recorded cases, and is probably brought about by irregular contractions in the two uterine horns.

The operation can only be performed where the two halves are absolutely symmetrical. It is very easily carried out. A V-shaped wedge is removed, and the two halves of the uterus are brought together and carefully stitched. There was no difficulty in approximating the two halves. All the sutures should be inserted before any one is tied, and I inserted them through as much of the muscle tissue as possible. After tying the principal sutures, I inserted one or two stitches between, so as to bring the edges of the wound very accurately together. The suture used for the principal stitches was linen thread, and for the intermediate stitches fine catgut.

As recorded in the report of the case, the scar was unusually firm, for I passed my hand into the uterus after delivery of the child, when I could feel a longitudinal ridge running vertically along the anterior and posterior uterine wall.

Intravesical Repair of Inaccessible Vesico-vaginal Fistulæ.

By J. M. MUNRO KERR, M.D.

ALL surgeons must have found that there are certain cases of vesico-vaginal fistula in which the repair of the fistula is extremely difficult. In a number of cases the difficulty arises because of the size of the tear, but in others, probably the greater proportion, because the fistula is so difficult to reach *per vaginam*. This latter difficulty was the reason for the following operation.

The fistula in my case followed a radical operation for carcinoma of the cervix. The carcinoma was far advanced, and in separating the bladder from the cervix I injured the bladder. I tried to repair it as well as I could at the time, but unfortunately a fistula resulted. Some months later the patient came to me in great distress because of this fistula, and asked me if I could not do something to make her more comfortable. I found the fistula high up in the vault of the vagina, and so inaccessible that I deemed repair by the vagina impossible. I told her that I could do nothing, but a day or two later I thought it might be possible to repair it by the bladder. I therefore took her into my wards in the Glasgow Royal Infirmary and performed the operation as follows:—

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[1] *Berl. klin. Wochenschr.*, xl, p. 1750.

[2] *Ibid.*, 1913, l, p. 1589.

I made a transverse incision above the pubes and dissected down on to the bladder. I then seized the bladder with two fine volsellum forceps, about 3 in. apart, and opened the vault of the bladder transversely. I could then see the fistula clearly at the base of the bladder, and it was easy to reach it. With a knife I separated off the mucous membrane, and the muscle and mucous membrane of the vagina. My idea was to insert two layers of sutures and knot the one in the bladder and the other in the vagina. The bladder stitches I felt sure I could easily insert and tie, but the vaginal stitches were the difficulty. It occurred to me, however, that by taking straight needles and threading one on each end of my suture I could pass these straight needles down into the vagina and tie them there. I therefore proceeded to do this. I pushed the straight needles down into the vagina; I then applied my ligatures to the mucous membrane and completely closed the mucous membrane. I then carefully closed up the wound in the vault of the bladder and closed the abdominal wound. Next I seized hold of the needles which I had pushed into the vagina, removed them, and tied the ligatures firmly. It was a little difficult because they were so high up in the vagina, but with the aid of long pressure forceps I accomplished it quite easily. A self-retaining catheter was inserted into the bladder and retained for two or three days. The patient made an uninterrupted recovery, and the fistula was completely healed.

I do not wish at present to claim too much for this operation, for I have employed it only in this one case, but I think that it may prove useful in certain cases. It might not, however, be successful in some of those large vesical tears where it is extremely difficult to get a satisfactory union of the bladder mucous membrane *per vaginam*.

As far as I can discover, no one has suggested the procedure described—an intravesical repair of a vesico-vaginal fistula.

DISCUSSION.

The PRESIDENT recalled the publication of a paper by the late Mr. McGill, of Leeds, in the eighties, on the suprapubic operation for vesico-vaginal fistula, which he himself early followed. The free separation and dissection of the damaged tissues were the main requirements, and he considered the route *per vaginam* the more effective.

Dr. EDEN said that the closure of a vesico-vaginal fistula by a vaginal operation was much more difficult when the uterus had been previously removed than in one due to obstetric traumatism. The bladder could not be pulled down within reach, and the fistula was usually in the least accessible position—i.e., at the apex of the vagina. He had twice dealt with such a case by an abdominal operation, separating the bladder from the vagina from above downwards. It was, however, a technically difficult operation, and he could well believe that the intravesical route would prove to be easier in many cases. He said there was both simplicity and ingenuity in the technique as demonstrated by Dr. Munro Kerr.

Placenta Prævia, with Vasa Prævia; Cæsarean Section.

By ARTHUR J. McNAIR, M.B.

E. M., a frail-looking grey-haired woman, aged 39, was admitted into Guy's Hospital on August 11, 1920, on account of hæmorrhage in the thirty-fifth week of her first pregnancy. I am permitted by the courtesy of Mr. Harold Chapple to report this case. She stated that she awoke at 1.30 a.m., feeling very faint, and she discovered that she was losing profusely from the vagina. Up to then pregnancy had been uncomplicated. On her admission to the hospital half an hour later, the Obstetric Resident was so alarmed at the severe flooding that he immediately inserted a gauze pack into the cervix and vagina, and in so doing ruptured the membranes. When I saw her shortly afterwards, blood was already coming through an efficient vaginal pack. The patient was blanched; her pulse-rate was 140 a minute. The fœtus was presenting as a vertex in the first position, and was alive. After removal of the gauze, the cervix was found to be rigid, not taken up, and dilatation was only sufficient to admit one finger with difficulty. A marginal placenta prævia was felt. Hæmorrhage was so profuse that obviously it had to be stopped quickly. I decided that Cæsarean section held out the best hope of saving the woman, because the alternatives of version or the use of a de Ribes' bag both necessitated dilatation of the cervix with the certainty of increased bleeding. The feasibility of bipolar version was doubtful as the liquor amnii had escaped and treatment with a hydrostatic bag would have entailed the risk of further hæmorrhage on its expulsion from the cervix. These facts and a consideration of the patient's general condition were sufficient to outweigh the contra-indication of ruptured membranes.

This operation was accordingly performed under gas and oxygen anæsthesia. The fœtus, which weighed 5¾ lb., was delivered covered with meconium, in a condition of white asphyxia, but was resuscitated. The patient subsequently made a good recovery and left the hospital with her baby on September 12.

I record this case because examination of the after-birth showed that in association with a marginal placenta prævia there was a velamentous insertion of the cord so disposed that the spread-out vessels lay over the internal os uteri. It was discovered also that rupturing of the membranes had resulted in tearing of a large vein. It is remarkable that the fœtus survived what must have been a considerable direct hæmorrhage from its circulation.

The specimen consists of a placenta, on the uterine surface of which is a detached portion covered by blood clot. The velamentous vessels course over an area which was, in the recent state, as large as the palm of one's hand, and become inserted into the placenta in the lower two-fifths of its circumference. The laceration of the membrane involving a large venous tributary is shown. It was identified with certainty as the aperture through which the gauze was thrust, by the fact that its margin was stained with picric acid solution which had been used to swab out the vagina and cervix as a preliminary to operation.

DISCUSSION.

The PRESIDENT asked whether the severe blood-loss had any effect on the fœtus? In the only instance of the kind he, himself, had seen the child was born alive.

Dr. McNAIR said that the child was delivered by Cæsarean section three-quarters of an hour after the laceration of the vein occurred.

The Female Pelvic Floor:[1]

PRESIDENT'S ADDRESS.

(ABSTRACT.)

By Henry Briggs, F.R.C.S. (President).

Half a century ago, in the second of the five editions of his classical work, Henry Savage, after more recent dissections of the muscles of the floor of the pelvis, amended the defects of the first edition. Savage was acquainted with the subperitoneal perivascular connective tissue and its importance in the protection of the blood-vessels from strain; he also mentioned the additional trabecular filaments which strengthened it and allowed only a partial descent of the uterus. On the perinæum the minute care bestowed by Savage terrorized the assiduous student of the early seventies; the subtleties of scalpel and forceps subsided amid the shrivelled—too primitively prepared and preserved—tissues; the description on the authority of Savage (acknowledged within brackets) was accepted with disappointment after difficulty and diffidence. Free dissection dislodges connective tissue; disturbs, diminishes, or destroys organic continuity; isolates and lessens constituents and depreciates accurate description. Savage warned dissectors against these losses at a time when anatomical demonstrations of the tissues of the dead were more prevalent than surgical operations upon the living: the denudation operations,—in their tissue sacrifices slight, in their extent patchy, in their areas ranging from the perinæum to the vaginal fornices,—were too meagre, too superficial or too marginal, to originate any new departure in plastic surgery. The structure and functions of the pelvic floor were not understood; dissection and description had effected too little; extensions of anatomical methods were required; from sectional anatomy revelations were impending.

In 1872, in obstetrics, a sensational surprise was lodged; thoughts aroused; corrections made and researches widened by Braune's illustration and description of his frozen section.

In 1880, Berry Hart, with an acute perception of Braune's revelations and of the essentials of regional obstetrical and gynæcological anatomy, published his own researches on the structural anatomy of the female pelvic floor, including a further study of the genu-pectoral position. In 1885, Hart also published the topographical and sectional anatomy of the female pelvis. Of Hart's foundation-study of the pelvic floor my own, ever-increasing, estimate commenced in 1880 at the close of a three-years' demonstratorship of anatomy and continued from 1885 throughout a thirty-five years' honorary service in obstetrical and gynæcological hospitals. I believe my own estimate to be a very small fraction of the—general and genuine—deserved appreciation.

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[1] At a meeting of the Section, held October 7, 1920.

It is difficult to persuade man that his contemporaries are valuable and important persons. It is easy for man to realize that scientific departments and learned societies are willingly allied in the encouragement and support of all good work.

Strong anatomical support of Hart's foundation appeared. By invitation from the Edinburgh Obstetrical Society, on the completion of his own additional scientific researches, Professor Johnson Symington in 1887 read "A contribution to the Normal Anatomy of the Female Pelvic Floor";[1] in confirmation and in criticism of Hart's foundation, he stated:—

> "The importance and variety of the functions performed by the pelvic floor, no less than the frequency with which its structures are impaired, render an accurate knowledge of its anatomy and physiology an essential preliminary to the scientific study of gynæcology and obstetrics; yet, with the exception of Dr. Berry Hart, few writers have devoted much time to the investigation of its general topography, or of the changes that may occur in the position of its different parts under various physical conditions.
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> One of the most obvious functions of the pelvic floor is that of supporting the superimposed viscera. This is especially the case in the human subject, for the weight of the abdominal viscera, which in most animals is largely borne by the ventral wall of the abdomen, tends to become transferred, with the assumption of the erect posture, from this wall to the pelvic floor. The pelvic floor is not, however, merely an organ of support, since it contains canals by means of which the urinary, genital, and alimentary tracts communicate with the exterior, and through which the contents of the bladder, uterus, and rectum can pass to the exterior. In the process of parturition the floor must be capable of very great displacement, as the diameters of the fœtal head are nearly equal to those of the pelvic outlet.
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> In this paper the term 'pelvic floor' includes not merely its muscular diaphragm, but the whole of the soft structures that close the inferior outlet of the female pelvis. It is composed of skin, mucous membrane, fasciæ, muscles, and fat, arranged in such a manner as to form a thick and tolerably compact mass. There is no difficulty in defining the lower limit of the pelvic floor, as

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[1] *Edin. Med. Journ.*, 1888-9, xxxiv, p. 788.

all will readily admit that this is formed by the skin. With the upper boundary the case is different, since here the difficulty is to determine whether certain organs, which are connected with the pelvic floor, ought to be considered as entering into the formation or as resting upon it. Thus Dr. Berry Hart describes the bladder as forming an important part of the anterior portion of the pelvic floor, and Dr. Henry C. Coe, in his article on 'The Anatomy of the Female Pelvic Organs,' in the 'American System of Gynæcology,' i, p. 222, published in 1887, stated that, properly speaking, the term includes both bladder and rectum.

For various reasons I feel compelled to differ from these authors, and to consider that the rectum and bladder, like the uterus, should not be regarded as parts of the pelvic floor, but as organs resting upon it. Dr. Hart has specially emphasized the fact, that the pelvic floor forms a compact mass, which is traversed by certain 'clefts' or 'faults,' the walls of these clefts being normally in contact, so that they bound merely potential spaces. I quite agree with this view, but would add, that although these clefts may open up for the passage of material through them, they do not act as reservoirs like the cavities of the bladder, uterus and rectum. If we regard the bladder as constituting a part of the pelvic floor, then we must admit that the floor rises up into the abdomen when the bladder is distended."

An obstetrician's (Hart's) realization had enlarged the pelvic floor downwards to include both the pelvic diaphragm and the perinæum, also upwards to include the bladder in the pubic segment. An inclusion of the bladder embarrassed the term pelvic floor; accordingly scientific anatomists have followed Symington and excluded all the overlying viscera. The complete closure of the unoccupied visceral canals—the "clefts" or "faults"—within the pelvic floor from peritoneum to skin is an important physiological and prophylactic function as well as an invaluable physical feature for clinical discernment.

Did Douglas ever inquire as to the closure of the pouch that overlies the pelvic floor and bears his name? When occupied, the pouch of Douglas has long been familiar as a mine of gynæcological activity. When empty, the close contact of its walls is consistent with the similar disposal of the walls of the "clefts" within the normally firm pelvic floor. Above and within the pelvic floor close packing and laxity of tissue are incompatibles; close packing and firmness of tissue are inseparables. The firmness of the pelvic floor is ascribable to the mixed—the most active to the most passive total constituents. Amongst them the voluntary muscles are prominent and are lucidly summarized in Professor Peter Thompson's introduction to his published thesis on the "Myology of the Pelvic Floor," 1899. Thompson states (p. 7):—

"In view of the supreme importance of a precise and accurate knowledge of the anatomy of the pelvic floor to the gynæcologist and obstetrician, it is perhaps not surprising that special attention should hitherto have been chiefly directed rather to its topographical anatomy in the human subject, and particularly in the female, than to its morphology and comparative anatomy. It is, however, none the less remarkable that amidst the numerous and indeed almost exhaustive observations which have been made in comparative myology, the muscles of the pelvic floor have received but scant consideration.

The pelvic floor, as so well pointed out by Dr. Berry Hart and Professor Johnson Symington, is a thick compact mass traversed by 'clefts' or 'faults,' the walls of which are normally in contact, but which open up for the passage of material through them. It includes the whole of the soft structures that close the outlet of the pelvis.

In the human subject, in whom the erect posture necessitates special modifications, the functions which the pelvic floor is called upon to perform are widely different from those in animals in which the long axis of the body is horizontal. In most mammals the weight of the abdominal viscera is largely borne by the ventral wall of the abdomen, but in man the weight is sustained mainly by the floor of the pelvic cavity, and this is accordingly specially modified to give active support to the burden which has been transferred to it.

In all mammals the closure of the 'clefts' or 'faults' in the pelvic floor, through which the rectal and genito-urinary canals are transmitted, is brought about by the action of muscular fibres, and the compact mass forming the floor of the pelvis is, therefore, even in its simplest form, partly muscular; the rest is made up of connective tissues and integument. The muscular fibres, which form a distinct layer in the pelvic floor, surround the canals which traverse the 'clefts' and they control or guard these canals at their outlet; in other words, the layer is largely sphincteric in action. It is obvious that a pelvic floor so constituted is not specially adapted for support.

But a great difference in the architecture of the pelvic floor is apparent in those mammals in which the long axis of the body is either absolutely, or approximately, vertical. In them the floor is further modified for the support of abdominal viscera, and, in addition to the layer of muscle controlling the clefts, another layer is developed in the form of a well-marked diaphragm, which constitutes a muscular sheet attached on all sides to the walls of the pelvic cavity. In the human subject this sheet includes the levatores ani and coccygei muscles.

The more highly differentiated pelvic floor, therefore, consists of a compact mass in which two distinct layers of muscles may be recognized, the arrangement and functions of which are in striking contrast. The upper layer, designed for purposes of support, forms a more or less complete 'pelvic diaphragm;' the inferior layer, designed for purposes of control, forms sphincters for the openings of the canals which perforate the floor to reach the exterior.

The two layers are not functionally but morphologically different. The sphincter muscular layer is derived from the primitive sphincteric cloacæ, and though the muscles differentiated from it vary in the lower and higher types of mammals they follow a general plan of organization.

As regards the pelvic diaphragm it is interesting to find, that although it contributes to the support of viscera, the muscles which constitute it are derived from the flexors and abductors of the caudal end of the vertebral column. In tailed mammals this group of muscles passes from the side wall of the pelvis to the tail and moves that structure. But coincident with the assumption of the upright posture not only is the number of caudal vertebræ reduced, but the muscles which move them undergo similar retrogressive changes. This group is now available for other functions, and it eventually undergoes such modifications as to form the diaphragm, which is such an essential feature of the pelvic floor in some of the primates.

The two muscular layers of the pelvic floor described above, can be recognized in anthropoid apes and man, and although in dissecting the perineum of the latter, the number of muscular layers may be greater, the increase is due, not to the presence of a third layer differing in function or origin from the two described above, but to modifications affecting the lower layer in such a way that its various muscles are arranged in two chief planes or strata.

In this thesis an attempt is made to describe in detail the two fundamental muscular layers of the pelvic floor; to trace the origin and development of the muscles forming each, and to compare these in their different groups of mammals; and finally to establish their homologies."

A further step in the advance of scientific anatomy was also made by Thompson with regard to "The arrangement of the Fasciæ of the Pelvis and their relationships to the Levator Ani." He states[1]:—

"The assumption of the erect posture—as in man, and approximately so in anthropoids—necessitates special modifications for the support of the pelvic viscera. Of these, perhaps the most important are the modifications which the ilio—and pubo—coccygei muscles undergo to form the levator ani. At the same time, the presence of a strong visceral layer of pelvic fascia, obviously for purposes of support, which extends between the viscera and the lateral pelvic wall, is suggestive of another modification of structure to meet special requirements. But whereas the homologous muscles of the levator ani in man can usually be recognized without difficulty in lower mammals, this is not the case with the visceral layer of pelvic fascia. Apparently it does not exist as such in lower mammals, and consequently it must be regarded as a new formation."

"Since then, in mammals below primates there is no visceral pelvic fascia similar to that occurring in man and the orang-utan, one may, in conclusion, ask: What is the origin of the fascia? It is difficult to give a definite answer to this question. But at any rate we know that a fibrous sheath envelops the obliterated hypogastric artery, and the vessels supplying the bladder, uterus, vagina, and rectum, and it may be that the supporting layers of the pelvic fascia are primarily derived from this, by lateral extension on to the fascia covering the upper surface of the levator ani. There is one circumstance that seems to lend some support to this view, namely, that in the orang-utan the visceral layer of the pelvic fascia, at least in its hinder parts, is double, and some of the vessels derived from the hypogastric trunk are situated between the two layers. But further observations are necessary to elucidate this point."

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[1] *Journ. Anat. and Physiol.*, 1901, xxxv, p. 127.

The completing step in the structure and functions of the distensile and mobile pelvic floor is supplied in Manfred Moritz's published article on "The Significance of the Parametrium."[1] Moritz stated :—

> "These observations, excluding all the other elements, leave us therefore the vessels, nerves, lymphatics and ureters, with their sheaths of smooth muscle, alone, together with the retroperitoneal connective-tissue in which they run as the chief factors—I venture to submit the only ones—which come into consideration in regard to the support of the pelvic viscera. I fail to see any difficulty against the acceptance of this view. The tissue has obviously been evolved, and is eminently adapted for this formation. The fact, that the lower uterine segment forms, relatively speaking, the most fixed point, gives to this organ free play for the great changes in size and shape to which it is periodically subjected, and enables it to fulfil its physiological functions.
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> The structure of the connective tissue, e.g., the extensible vessels, strengthened by elastic masses of smooth muscle, allows all the changes of pregnancy, of full and collapsed bladder, and of rectum, &c., to take place without any interference with the normal state of these tissues and without vascular disturbances.
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> In addition to its advantages over a more rigid tendinous or ligamentous support, this tissue possesses a definite tonus of its own. It is actively contractile, ever variable in dimensions, and thus able to arrange itself for the varying conditions to which the pelvic viscera are liable, enabling these to carry out their functions comfortably and with the least expenditure of space and energy."

Of the available evidence from scientific, anatomical, or other, sources none could be more acceptable than the foregoing which are representative of the more widely conceived and conducted researches of an advanced and accurate character.

In the surgical restoration of the pelvic floor or of the abdominal wall, an operator relies upon the firmer fasciæ rather than upon the packing connective tissues or the more vulnerable voluntary muscular fibres during the coaptation of all by layered buried sutures. Where there is little firm fascia there is little muscle, also little packing connective tissue exclusive of the variable fatty deposits; surgical effort is then too late.

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[1] *Journ. Obst. and Gyn. Brit. Emp.*, 1914, xxvii, pp. 177-189.

The firmness of the normal pelvic floor and the harmonizing co-operation of all the constituents are belittled by an elated and exclusive advocacy of any one constituent. Here and there, too often, in the abundant—if not superabundant—total literature, industry and elaboration, enthusiasm and imagination have advanced conflicting views, each displaying its modicum of truth and each when pushed to the extreme becoming almost frantically absurd. Assortment, amalgamation and sacrifice are ever in process.

In this Section of Obstetrics and Gynæcology, in 1908, sympathetic clear vision and sound judgment were exercised by Professor Arthur Keith.[1] By him the supporting function of the pelvic floor at the time was attributed to: "(1) the musculature of the pelvic floor; (2) the visceral ligament of the pelvic fascia as described and defined by Professor Paterson; (3) the strong perivascular and perineural sheaths." He endorsed the accuracy of the visceral ligament of Professor Paterson and added the independent observations by Dr. John Cameron and Professor Elliot Smith—namely, the continuity of the visceral ligament on each side with the perivascular supports, especially with the extremely strong fibrous sheaths surrounding the prostatic vaginal and uterine veins.

The primary function of the visceral ligament met with a dissentient judgment from Professor Keith, based: (*a*) upon the mechanism of the bladder *in situ* behind the pubis on its visceral ligaments, and (*b*) upon a warning note that without any elongation of the visceral ligaments, but between them, the yielding and prolapse of the centrally placed trigone musculature is due to the injured and weakened levator ani and sphincter vaginæ.

The late Professor Paterson, when his description of the visceral ligament was ripe for publication, sought my views on the visceral pelvic fasciæ; as they agreed with his findings he seemed pleased with them in spite of my protest against the naming of ligaments obtainable from visceral fasciæ of the pelvic floor.

In going about their surgical business operators upon the pelvic floor, as elsewhere, like to think that they are applying their fullest and best regional and general anatomical knowledge on the widest and soundest local and general surgical principles. Operators do not court, neither do they deny their failures: they are aiming at conservation of tissue and function by earlier attention and action. A liberal conformity encourages the comparisons that tend to correct associations. Abdominal wall incisions and herniæ and pelvic-floor puerperal lacerations and herniæ with their wall and floor injuries and defects can be studied and treated on parallel lines. In their presence time, opportunity, judgment and equipment vary and the degree of departure from the normal wall or floor also varies. Among old standing gross departures from the normal, failures of radical treatment are reasonable expectations; the tissues are atrophied: their functions are lost beyond restoration. Early and slight departures from the normal can only be diagnosed and their intensification verified by an exact appreciation of the structure and functions of the normal pelvic floor. Modern utility and future service are severe tests of isolated distinctions like Mackenrodt's and Paterson's within fascial planes.

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[1] *Proceedings*, 1908, i, p. 216.

There was much to be sought and taught, at the middle of the sixteenth century when the French surgeon, Ambrose Paré, led the way for his confrères and successors in the primary treatment of perinæal lacerations which had converted the two openings into one. There were sutures and their effects—a too cramped co-aptation of all the tissues of the torn septum. A general and a surgical shyness towards primary suture, especially in this country, persisted.

Gynæcologists admit that the downward—the commonest—displacement of the uterus is a hernia.

Publications on the use and abuse of pessaries were infinitely less potent than Sir John Bland-Sutton's recent postulate, "the proper place for a pessary is behind the fire"—one of the innumerable beneficent changes introduced by modern surgery in the treatment of gynæcological disease! A pessary owes its support to the pelvic floor or to a mechanically devised substitute.

It is difficult to be scrupulous and thorough when the uterus and its supports are, in prejudice and in debate, always in evidence.

During the child-bearing period of life, amputation of the cervix and other sacrifices of tissue are rarely pardonable in plastic surgery.

Once a hernia always a hernia: once a weakened pelvic floor always a weakened pelvic floor.

The scientific knowledge of the pelvic floor has been founded well and mainly within half-a-century. It is hardly a ridiculous summation of the structure and functions of the pelvic floor that blends an upper diaphragmatic stratum with a lower cloacal stratum or, if preferred, that links together the one—diaphragmatic—with the other—subdiaphragmatic—each peripherally coterminous with the pelvic outlet and together filling the pelvic outlet from the peritoneum to the skin. Such a summation of firmness suggests the antithesis—scantiness.

The flap-splitting perinæal operations began in the right permanent way: they did not go far enough in depth and width: at their best beginnings they were subcutaneous and over, rather than among, the weakened tissues.

The perinæal body confers its own bulk on the sacral segment of the pelvic floor by fusion with the pelvic diaphragm: the sleeves of visceral pelvic fascia surrounding the rectal and vaginal walls are prolongations downwards of the fasciæ of the pelvic diaphragm: by surgically free separation of these sleeves through the perinæal body, under and partly around the vagina as far as the peritoneum of the pouch of Douglas and in front of the rectum, the fasciæ and muscular tissues of the pelvic diaphragm itself are approachable. The lithotomy position of the patient has established itself both in the examination and in the treatment.

Primary suture of lacerations of the sacral segment of the pelvic floor must be thorough and extended to the loosened and the torn fascial sleeves for the replacement of rectal and vaginal canals, otherwise the intermediate diaphragmatic and perinæal fasciæ and muscles are permanently cramped and perhaps immediately neglected.

Primary suture of the pubic segment of the pelvic floor is seldom needed: it is raised during parturition and is kept raised and supported after parturition by the fully repaired sacral segment.

Firmness of the pelvic floor and complete closure of its canals or clefts are attributes of normal development, structure and function. If their attainment is surgically possible it will not be by neglect of the pelvic diaphragm during a perinæorraphy, which should be extended to a repair of the pelvic floor by elevation of the posterior and posterolateral walls of the vagina, to expose for suture the separated firm tissues of the pelvic diaphragm.

The value of Paramore's elaborate defence of the levatores ani and their adjacent fasciæ ought to be daily asserted in obstetrics and gynæcology.

The meaning of the term perinæum is generally correctly interpreted as the lower region of the pelvic floor; conveniently subdivided but confusedly described. A tint of shame or a flash of levity is the sensation of a reader of its many popular dictionary definitions, for anatomists are not necessarily philologists. The following derivations have been suggested:—

Quain's Anatomy (the last edition): περι ; ναίω, am situated, denotes little advance on

Mayne's Expository Lexicon (1860): περι νεω, to flow around, because it is generally bedewed with moisture.

Webster's Dictionary: N.L. fr. Gr. περίναιον περίνεος. (Anat.) The region which is included within the outlet of the pelvis, and is traversed by the urino-genital canal and the rectum.

Murray's (Oxford) Dictionary: Perineum, Lat. (late circa 450) perinaeum, from Gr. περίναιον from a Greek word for scrotum, according to Hippocrates, πηρίν, or according to Galen, περίνεον = περίνα.

To my colleague, the Professor of Greek in the University of Liverpool, I referred for a possible explanation of περίνεος, περίνεον, also for any other enlightenment; in reply he wrote to me:—

"DEAR PROFESSOR BRIGGS,

"Your problem respecting περίνεος is not easy. There was clearly a word, πηρίς, a derivative of πήρα, *a wallet*, used in the sense of 'scrotum,' and there is some evidence of a subsequent πηρίνα, said to have been employed by Galen as equivalent to περίνεος, i.e., the tegument extending from the fundament to the scrotum. All that seems reasonable enough. But the origin of περίνεος (we need not trouble as to the variant, αιος), is far from clear. I do not think we can divide περι—νεος (or —ον), for to suppose that the adj. νέος is involved would run counter to the principles of Greek composition. One is tempted to conjecture that περινα-—ιο is dialectal variant to πειρινα—ιο—: πηρίνα, which would clear up the difficulty. But you must not place the least confidence in this; it is probably the merest moonshine, as I have no claim to speak as a philologist. Besides, the fact that Ionic was the traditional medical dialect puts a hypothetical Doric out of the question. I will look round in the library to-morrow to see if I can get any fresh light. If you hear no more, please infer that I have failed, and that περίναιον and περίνεος are wrapt in obscurity.

Yours sincerely, A. C. PEARSON."

The term obstetrics literally means "standing before"; ante-natal service lightens anxieties and dangers; let there be added the pelvic floor repair resembling the abdominal wall repair carried out after a well conducted abdominal section. Local supervising authorities under the Midwives Act are awakening to this provision.

Section of Obstetrics and Gynæcology.

President—Mr. Henry Briggs, F.R.C.S.

Acute Inversion of the Uterus; Treatment by Blood Transfusion and Late Replacement.[1]

By J. Barris, F.R.C.S., and M. Donaldson, F.R.C.S.

(From the Maternity Department of St. Bartholomew's Hospital.)

A. H., housewife, aged 34, was admitted on August 12, 1920, on account of collapse and hæmorrhage following labour.

Past history: The patient had been married for six years, and had been pregnant twice before.

History of present condition: Her third labour, which was conducted by a midwife, began at 3 a.m. on August 12, and a child weighing 7 lb. was born at 6.5 a.m., the perineum being torn incompletely. The placenta did not come away spontaneously; at the end of two hours the midwife endeavoured to express it, and at the same time pulled on the cord. The placenta was delivered by these manœuvres, but profuse hæmorrhage followed and the patient stated that she felt something come down. A doctor was called in and she was admitted to hospital at 5 p.m.

The following observations were made shortly after her admission: The patient appeared blanched and collapsed; temperature 98° F., pulse 120 per minute. On examination of the abdomen a swelling identified as the uterus was found rising to a height of 4½ in. above the pubes. In the position of the fundus a distinct cup-shaped depression could be felt. The vagina contained much fresh blood and blood clot. The fundus uteri could be felt projecting through the external os and lying just inside the vaginal orifice. A diagnosis of acute inversion was made. Owing to the collapsed state of the patient, the persistence of hæmorrhage, and the lapse of several hours since the occurrence of the condition, it was decided to treat the patient for collapse and hæmorrhage, and to postpone the replacement of the uterus. Pituitrin 1 c.c. was injected hypodermically and a hot vaginal douche was given.

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[1] At a meeting of the Section, held November 4, 1920.

Two days later the red cells numbered 1,800,000 per cubic millimetre, and the patient was transfused with blood, using the citrate method. Owing, however, to a fault in the apparatus, not more than 100 c.c. of blood could be introduced. The patient continued to bleed and on August 27 the red cells numbered only 1,200,000. After much persuasion the patient agreed to have the transfusion repeated, and this was carried out on September 3, to the extent of 600 c.c., the citrate method again being used. The effect was marked and immediate, the number of red corpuscles on September 4 rising to 2,570,000.

Local sepsis was evident within three days of admission and was treated by means of Carrel's tubes inserted into the vagina, a solution containing 1 in 4,000 potassium permanganate and 1 per cent. sodium sulphate being used. The irrigation was continuous, and so regulated that by changing the pads every three hours the bed remained dry.

On the sixth day after admission, during the act of micturition, the fundus became completely inverted and protruded from the vulva. As this was accompanied by considerable shock, the fundus was wrapped in sterile gauze but not replaced. Three hours later it was irrigated with saline, a small piece of sloughing placenta was removed, and the uterus was pushed back into the vagina only.

Reposition of the uterus, which had involuted well, was carried out on September 29—i.e., nearly seven weeks from the date of admission, by means of Aveling's repositor, and was complete within nineteen hours after the instrument was applied. The repositor was removed from the uterine cavity after five minutes' gentle traction.

The patient was seen by one of us on October 4. She appeared in good health; the fundus uteri was normal in situation and contour, and there had been no bleeding from the vagina.

This case presents several points of interest. First, it is an addition to those cases recently described by Dr. Herbert Spencer at this Section; and it emphasizes the value of late reposition of the uterus, adopted by him. Secondly, it illustrates the great value of blood transfusion when marked anæmia is evident. Thirdly, it demonstrates how Carrel's tubes can be used for sepsis during the puerperium with ease and with no discomfort to the patient.

DISCUSSION ON LATENT SYPHILIS AND PREGNANCY.[1]

Pregnancy and Latent Syphilis.

By R. A. HENDRY, M.D. (Liverpool).

THE data now brought forward have been collected at some antenatal clinics in Liverpool between April, 1916, and July, 1920. The cases relate to what may be called latent syphilis, in that, apart from the effect on the pregnancy, there are no active clinical symptoms or signs of syphilis. As this excludes primary and secondary syphilis, diagnosis is the obvious preliminary step—and the obvious preliminary difficulty.

For its solution we have to rely on (1) the clinical and (2) the laboratory evidence: these may be further subdivided into the history of infection and the past obstetrical history, together with the Wassermann reaction and the examination of stillbirths, abortions and placentæ.

A history of primary or secondary syphilis is difficult and rarely possible to obtain; its absence is of no value.

In Table I, graphically expressed, is a series of obstetrical histories, selected from cases investigated, some syphilitic, others non-syphilitic.

The feature of the first eight is abortion—in two, preceded by a living infant. The absence of syphilis is sufficiently proved in Co. by the maternal death from cerebral hæmorrhage, a sequel of chronic nephritis, no evidence of syphilis at the autopsy and the repeatedly negative Wassermann in both husband and wife; moreover the father had six healthy living children by his first wife; and in Da. by the lack of any evidence of syphilis in the last three fœtuses born between the twenty-fourth and twenty-eighth week of gestation and by the repeatedly negative Wassermann in husband and wife.

In Wa., a non-syphilitic, macerated, premature fœtus following two abortions accompanies a positive + Wassermann.

Y. and F. are sisters, aged 24 and 26; both aborted in the third month, twelve and eighteen months ago. They are now six and seven months pregnant; the Wassermann in one is negative, in the other positive +.

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[1] At a meeting of the Section, held November 4, 1920.

E. and Hg. have had six and five abortions in the third month; they came under observation six and seven months pregnant; the Wassermann is positive + in each. They had premature infants, one of which thrives; the other only lived four days.

McD., with a positive Wassermann, contrasts with Da.

Mg. is a non-syphilitic negress whose treatment was limited to iron.

Hs. reported alternating abortions and living children; Wassermann positive, she declined treatment, became pregnant, and had an infant which only lived two hours; she then returned for treatment. The infant was not available for examination.

A few preliminary abortions would convert Do. into a text-book history, which, in this series, is conspicuous by its rarity.

R. was an unpleasant surprise; only three children out of eight lived for more than a few months—many of the labours were instrumental, all were difficult; with this history pelvic contraction was sought and confirmed; an induction at thirty-six weeks was followed by a reasonably easy labour, but the 6½ lb. male infant only lived three hours. The Wassermann reaction was then positive; that of the fœtus, in spite of an unusually thorough examination, was negative.

Ck. suggests syphilitic infection after the first pregnancy; with a negative Wassermann, treatment was limited to iron and was followed by a healthy and thriving infant.

Mr. was one of the first cases in which a negative Wassermann accompanied a positive fœtus. By an unfortunate lack of co-ordination the result of the examination of stillbirth No. 2 remained with the laboratory worker; the Wassermann result, obtained some months later, remained with the clinician. Stillbirth No. 3 then appeared, and, on inquiry, it was found that the Wassermann had been negative at six months. To find out when, if ever, the Wassermann became positive it was proposed to make weekly examinations; four days after labour the Wassermann was already positive. A living infant has since been born.

O.'s seventh child was stillborn, the first six are living; the stillbirth was not examined. As the Wassermann was positive ++ she was referred to a venereal disease clinic.

B.'s first infant was macerated, her second is living; then followed three not macerated stillbirths and two abortions. As the Wassermann was positive she was referred to a venereal disease clinic; no subsequent pregnancy has been recorded.

Ma. had two macerated infants by her first husband; thirteen years later she remarried and became pregnant; Wassermann positive ++ at the second month: a healthy infant was born at term.

W. is a neurotic individual with interstitial keratitis, deafness, and suspiciously pegtop teeth, and, when three months pregnant, a positive Wassermann. Her first child had died of "meningitis" at 4 months. Her second, after five months' treatment, was born at eight and a half months and lived ten days, the family doctor considered it a congenital syphilitic. The Wassermann, two months later, was negative. Treatment was continued, and seven months later, when two months pregnant, the Wassermann was again positive. She now has a thriving baby.

In the first fifty-seven cases where a diagnosis of latent syphilis was made, the obstetrical history was analysed in detail. Forty-eight abortions and seventy-five stillbirths occurred—a total of 123 ante- and intra-natal deaths—as compared with ninety-six live births, of which thirty-three died, at least nine of the thirty-three during the neonatal period.

This analysis, with the table already considered, is, I think, sufficient to show that the obstetrical history is not a reliable guide in any given case.

The laboratory evidence is practically on two counts—the Wassermann reaction and the examination of stillbirths, abortions and their placentæ.

The Wassermann reaction is, at present, the evidence on which we have chiefly to rely. Between April, 1916, and July, 1920, 348 reactions have been examined for me in connexion with these clinics, 173 were positive and 175 negative.

A closer analysis of these is interesting. Up to the end of 1918, sixty-five positive and eighty-eight negative were reported. About this time two changes occurred: first, after August, 1918, the Wassermann results, hitherto reported as a straight positive or negative, were reported in four grades—negative, slightly positive, positive +, and positive ++; secondly, as the result of a few surprises, the blood was examined in practically all cases where stillbirth was not the obvious result of dystocia, and where abortion had occurred in the last pregnancy or had been repeated. I expected a larger percentage of negatives. From January, 1919, to July, 1920 (inclusive), sixty-three positive + or ++ and eighty-seven negative were reported, a singularly close agreement with the earlier figures of sixty-five and eighty-eight. In addition forty-five were slightly positive, the significance of which is open to discussion. My colleagues on the venereal side, I understand, disregard a slightly positive until they can have a repeat test, possibly after a provocative injection. They are in the happy position of being able to "wait and see"—the obstetrician sees "full-term" approaching steadily and can only delay treatment at the expense of the fœtus.

While the possibility of a negative Wassermann during pregnancy is now well known, its frequency is problematical; seven such cases have been found, chiefly during investigations in the Department of Obstetrics in the University of Liverpool.

On the whole, I think, it is reasonable to consider that a Wassermann reported positive in any degree, justifies the institution of anti-syphilitic treatment, but that such patients should not be pressed to attend a venereal clinic, as some—one need not guess at a percentage—are not syphilitic, and the consequences of such pressure might be serious.

Moreover, difficulties may arise when, as sometimes happens, the blood is examined for the venereal clinic in a different laboratory using another technique: in fairness, it must be stated that the results usually agree, but at least two patients have been referred to venereal clinics with a Wassermann reported positive +, and the blood on examination in a different laboratory, reported negative. I need not describe the patients' comments.

Positive evidence in the fœtus—*Spirochæta pallida*, chondro-epiphysitis and, more or less masked by the post-mortem maceration, changes in other organs, notably the liver, spleen and lungs, is generally held to be reliable. Negative evidence in the fœtus, in my experience, is equally reliable.

In abortions, particularly the early ones, conclusive evidence of syphilis is rarely obtained in the fœtus: there does not as yet seem to be unanimity in regard to what is acceptable as reliable evidence in the placenta and membranes.

The drawback in regard to this evidence is on the score of quantity rather than quality; in the past it has been rarely available; in the future, owing to the fact that so many fœtuses are now being examined, it will be much more widely obtainable; and, in time, will result in the earlier institution of treatment.

Turning now to the treatment, the results of which are shown in Table II in three series:—

First, those who had no treatment. The majority of these came under observation soon after the event: in some the pregnancy terminated before treatment could be instituted, others did not attend after the blood was taken for examination.

Secondly, those in whom treatment was begun during the pregnancy.

Thirdly, those under treatment when the pregnancy began.

The two negative Wassermann reactions in "stillbirths, no treatment," accompanied positive fœtuses.

One patient appears in "living infants" twice: On the first occasion, Wassermann negative, one injection of galyl; on the second, Wassermann slightly positive, no treatment. Exception might be taken to the inclusion of this case, were it not that a definite history of infection, confirmed by a syphilologist, accompanied her.

The arseno-benzol derivatives were not used as the clinics were held in premises loaned for the few hours necessary, and no provision could be made for cases requiring to be kept under observation for some hours in the event of mishap.

Mercury was therefore the remedy adopted. Four cases in the early days had galyl (three had one injection each, one had three). As they had to be sent up to hospital for these, and sometimes forgot their appointment, or the obstetric assistant, who gave the injections, was "on the district," they were not found practicable, and were abandoned.

For two years I persevered with intramuscular injections of grey oil, but the slight stiffness resulting caused so many complaints—with I believe little foundation—that they were abandoned, except in a few cases, in favour of hydrarg. cum creta, 1 gr. thrice daily by the mouth.

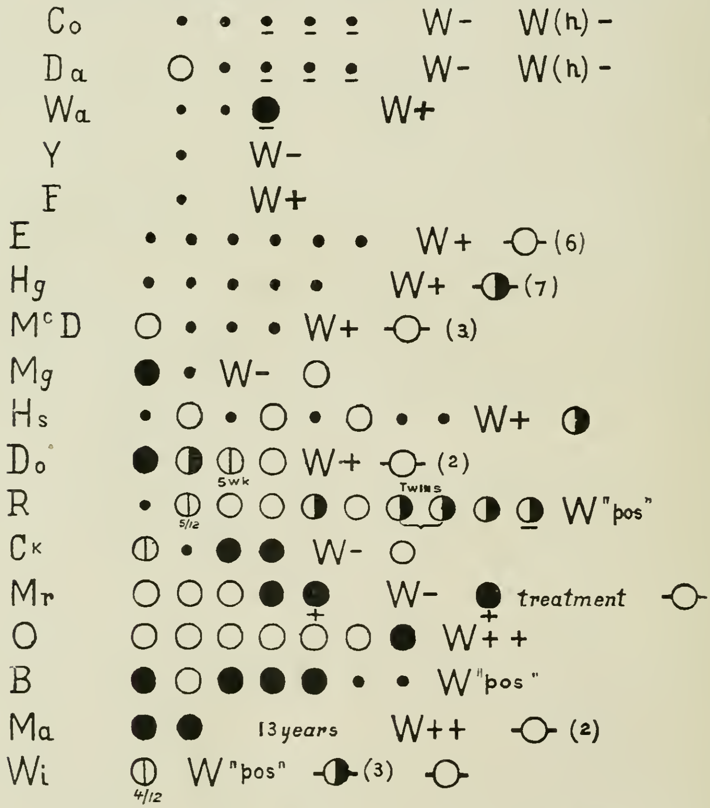
When the venereal clinics were established, many cases were referred to them for treatment; for various reasons these women did not report at the ante-natal clinics, and only six results are to hand for this table. They are included in the totals, but are indicated separately by the figures in the brackets.

It is necessary to avoid confusion between *post hoc* and *propter hoc* when considering the results of treatment in such a disease as syphilis. The first group is a reminder that apparently healthy children may be born at term without any treatment. Doubtless if treatment had not been instituted in the second group there would have been some live births; the date of the pregnancy at which treatment began ranged from the first to the eighth month; one patient, after six abortions, all under twelve weeks, began treatment at twenty-six weeks, and had a surviving baby at thirty-three weeks. Any division of this group into satisfactory and unsatisfactory treatment is open to abuse.

The benefit of the treatment can be stated much more positively in the third group, as these cases had graduated through the first two groups, where they swell the totals on the wrong side of the line.

TABLE I.

OBSTETRICAL HISTORIES.



• ABORTION.

● STILLBIRTH.

◑ NEONATAL DEATH.

⦶ LATER DEATH.

○ SURVIVING.

● +or− RESULT OF EXAM. OF S.B.

W + or − WASSERMANN REACTION.

W (h) " IN HUSBAND.

-○- ( ) TREATMENT BEGUN. AT ( ) MONTH.

TABLE II.—RESULTS AND WASSERMANN REACTIONS.

		Abortion	Stillbirth	Neonatal death	Infant living
No treatment ...	43	15 Pos. 6 Pos. sl. 8 Pos. + 1	17 Pos. 3 Pos. sl. 4 Pos. + 5 Pos. ++ 3 Neg. 2	4 Pos. 2 Pos. sl. 2	7 Pos. 1 Pos. sl. 5 Pos. ++ 1
Treatment begun during pregnancy	40 (5) (4g)	2 (1g) Pos. 2	4 (1) (1g) Pos. 3 (1g) Pos. sl. 1 (1)	5 Pos. 3 Pos. sl. 1 Pos. + 1	29 (4) (2g) Pos. 6 (1) (1g) Pos. sl. 10 (1) Pos. + 9 (2) Pos. ++ 3 Neg. 1 (1g)
Under treatment when pregnancy began	11 (1)	—	—	—	11 (1) Pos. 5 (1) Pos. sl. 2 Pos. + 3 Neg. 1

Figures in parentheses ( ) = cases treated at Venereal Diseases Clinics.
,, ,, (g) = ,, ,, by galyl.

TABLE III.—PERIOD OF GESTATION AT WHICH TREATMENT WAS BEGUN.

Abortion	Stillbirth	Neonatal death	Infants living								
2 (1g)	4 (1) (1g)	5	29								
				Months							
Pos. 1 mo. 4 mo. (g)	Pos. 3 at 5 mo. (1g)	Pos. 3 3, 5, 7 mo.		1	2	3	4	5	6	7	8
	Pos. sl. 1, 4 mo. (1)	Pos. sl. 1 7 mo.	Pos. 6 (1) (1g)	1 (g)	2	1	1 (1)	—	—	1	—
		Pos. + 1 6 mo.	Pos. sl. 10 (1)	—	2	—	3	—	2	3 (1)	—
			Pos. + 9 (2)	—	—	1	3 (2)	2	2	—	1
			Pos. ++ 3	—	1	—	—	—	—	—	2
			Neg. 1 (g)	—	—	—	—	—	1	—	—
				1	5	2	7	2	5	4	3

The following conclusions are, I think, justified:—

(1) That the clinical evidence of syphilis is unreliable.

(2) That the Wassermann reaction is the test by which, at present, the diagnosis must usually be made; it must be borne in mind that a negative or a slightly positive reaction may accompany syphilis during pregnancy, and moreover that a positive may occur in a non-syphilitic individual.

(3) That the examination of stillbirths, &c., furnishes reliable but, at present, insufficiently available, evidence.

(4) That the institution of mercurial treatment before the pregnancy justifies a favourable fœtal prognosis.

(5) That the prognosis when treatment is begun during the pregnancy depends on the unknown degree of infection already present in the fœtus.

Latent Syphilis in Pregnancy.

By Amand Routh, M.D.

Dr. Hendry's paper on ninety-four cases of "Latent Syphilis during Pregnancy" will help to elucidate the many doubtful problems surrounding the subject, such as the causes of the latency of the infection, the anomalies and irregularities of the Wassermann reaction in both mother and child, and the determination of the best methods of treating both mother and child during and after the pregnancy, so as to cure the mother and prevent congenital syphilis in the child.

Previous to the discovery of the infecting agent of syphilis, and the Wassermann reaction in 1905-06, and of salvarsan and its arsenobenzol substitutes since 1909, obstetricians were familiar with cases of women who had repeated abortions, or stillbirths, or who had borne living but syphilitic children. Unless there had been evidence of primary or secondary symptoms. often entirely absent, in these women before or during pregnancies, it was often impossible to get any clinical evidence of syphilis. The husband perhaps gave a history of previous syphilis, often six or eight years before marriage, and had remained perfectly well. In the absence of the Wassermann test for the father, mother and surviving children, and of any knowledge of the presence of the *Spirochæta pallida* in the tissues of a stillborn fœtus, a diagnosis of syphilis was hardly ever certain, and treatment by mercury in private practice such as that adopted by Dr. Hendry in his series of hospital cases, could only be adopted with difficulty owing to the hostility of the father to the view taken of the origin of the stillbirths.

As a result, however, of giving mercury to the mother during the pregnancy healthy children were born, but it was rarely possible to continue treatment to mother and child after the birth, and if other healthy children were desired, it was necessary to repeat the treatment of the mother in each successive pregnancy. If this was not agreed to, the next child was infected.

It was noticed, however, in untreated cases, that the virulence of infection in successive pregnancies appeared to be reduced, the woman's early abortions being succeeded by stillbirths, then living children becoming clinically syphilitic in a few weeks or at puberty, or the mother even getting a healthy child at the end of such a sequence, or even more rarely getting a healthy child during a series of stillbirths.

When the Wassermann reaction was discovered it was fully expected that it would prove to be positive in all women during pregnancy if they had had, or were about to have, a syphilitic child, and that the child, born alive, but destined to become clinically syphilitic in a few weeks, would, like its mother, prove to be positive. Instead of this many of these cases are negative, a fact which was difficult to explain satisfactorily.

I had often wondered why such an infection as syphilis, more severe thirty years ago than now, should ever allow a pregnant woman even after the admittedly salutary sequence of several pregnancies, to have a living, and apparently a healthy child. McDonagh had also noticed this point. It was evident also that there was a modification of the clinical evidences of syphilis in pregnant mothers, even though they were having dead or diseased children, but how could it be explained?

When the *Spirochæta pallida* was discovered in 1905, the puzzle became more difficult of solution, for the mature organism was found to be larger than the spermatozoon's head, and was a large infecting agent relative to the mature ovum.

If an ovum could be infected at the moment of fertilization, through the paternal semen, or by spirochætes in the mother's tissues previous to or subsequent to fertilization, it was impossible to understand why such a large infecting organism, capable of unlimited multiplication, did not invariably destroy the early delicate embryo, or to explain how such infected fœtuses ever survived their birth, to explain in fact how the infection of syphilis tended to become latent during the pregnancy.

Spirillolysis.—It is known now that the spiral of the mature spirochæte is able under the action of various substances, or even by a spontaneous spirillolysis, to break up into "granules," generally by a transverse division. Noguchi has observed that in pure cultures under certain conditions enormous numbers of minute granules occur, and that from these granules, after transference to a passive culture medium, spiral forms again sprout out; and in a remarkable article in the *American Journal of Syphilis* in April, 1917, he stated that he had made a series of cultures from recurring "granules" between 1910 and 1917 at the Rockefeller Institute, and was able from some of the strains to infect monkeys and rabbits from the resulting mature organisms. These and many other facts which I stated in my Harveian address (*Lancet*, January 12, 1918, p. 45), make it probable that the spirochæte may become granulosed during pregnancy, and also make it possible that in some cases infection may be by means of the granules and not by means of the mature organism. According to Sir F. W. Mott, Neisser, in his experimental investigation on apes, has observed that the tissues of infected animals in which no spirochætes were demonstrable, could nevertheless be used effectually for inoculation.

Chorionic Ferments.—The further problem is to determine the agents which nature has provided for this spirillolytic action on the *Spirochæta pallida* during pregnancy. It is evident it must be some agent which is present very early in pregnancy in order to prevent almost immediate destruction of the fertilized ovum infected by the *Spirochæta pallida*. Such agency must also continue in action during the pregnancy, or there would be no chance of a child being born alive or of surviving *in utero* long enough to be treated through its mother. As far back as 1914, in my evidence before the Royal Commission on Venereal Disease, and in my Harveian Address in 1918, I ventured to suggest that the chorionic ferments or "syncytial toxins" or their derivatives have this granulating power. These ferments of the chorionic villi are intended for trophoblastic purposes to facilitate the burrowing of the fertilized ovum into the uterine mucosa at the placental site. Any excess of the syncytic-toxins is apparently controlled or neutralized by so-called syncytic-lysins, as a result of the trophoblastic action on the maternal tissues. Failure of such control may be the cause of the various serious autotoxæmias of pregnancy. If the chorionic ferments are able to exert a destructive or digestive action on the local, probably prepared maternal tissues, it would probably be able to act chemically on the spirochæta, and make it break up into granules. The resulting granules are, I believe, kept biologically inactive by the ferments and remain "latent," so that they do not "sprout" or multiply in the tissues of the maternal or fœtal portions of the placenta so long as the chorionic ferments are present. So that no mature spirochætes are able in an ideal case to pass from mother to child or vice versa, and the infection during the pregnancy remains "latent." After pregnancy, chorionic ferments gradually disappear from both the maternal and fœtal tissues, (according to Abderhalden they cannot be detected in the maternal blood more than fifteen days after parturition); so that the biological activity of the granules is resumed, and the mature organism may become developed.

Irregular Wassermann Reaction.—Syphilitic infection rendered latent by the chorionic ferments explains several anomalies of the Wassermann reaction. Thus a pregnant *woman*, who in due course has either a stillbirth or living syphilitic child, may sometimes have a negative Wassermann reaction during pregnancy and for some weeks afterwards, for she will only have been infected by the latent granules and not by a mature active spirochæte. I believe this negative reaction in the mother can only occur in cases in which the ovum has been infected by the father's seminal fluid. After some weeks, when the chorionic ferments become absent, spirochætes may develop, and the woman's reaction may become positive owing to enough antibodies being produced in her body to excite a general reaction in her tissues and blood. The child, also, of such a mother would be negative at birth, and if the granules had been completely destroyed by the chorionic ferments, would remain negative; or if the granules had not been destroyed, they would become capable, in the absence of chorionic ferments after birth, of sprouting to form the mature organism, and the reaction would become positive shortly before the clinical evidences appear. It is also possible that a previously syphilitic woman, positive during pregnancy, may have a child born with a negative reaction, if the chorionic ferments or salvarsan, or both, have granulosed her spirochætes, and thus prevented them from invading the fœtal tissues.

Absence of Spirochætes in Abortion.—Eardley Holland and others have stated that spirochætes are rarely found in early abortions, even when expelled from a pregnant woman who has had syphilitic stillbirths crowded with spirochætes. This is a strange fact. I think the explanation is that spirillolysis has occurred, but has not prevented early fœtal death owing to presence of enormous numbers of granules which, if looked for, might be found, and in suitable media be further developed *in vitro*.

Infection through the Semen.—The possibility of the ovum being fertilized and infected by the semen, and of the woman being infected through the fœtus is not yet proved, but I believe it is real, for minute granules could be readily conveyed by the spermatozoa or in the seminal fluid and kept latent by the chorionic ferments. Sir F. W. Mott pointed out in 1914 that the spirochæte may be one form of the syphilitic organism, and that there may be other minuter stages analogous to the spores of bacilli, and he suggests that "these 'chromidian granules' may infect the head of the spermatozoon and subsequently multiply and produce the syphilitic lesions." I have assumed that this infection occurs by means of granules resulting from spirillolysis, which are kept latent during pregnancy. If, however, the mature organism were conveyed by the semen, it would promptly be granulosed by the ferments, and both the fœtus and the mother would only be infected by the granules, and both would have negative reactions immediately after parturition and as long as the inhibition of the chorionic ferments was present.

Intervening Healthy Children. — The occasional birth of an apparently healthy child amongst a series of dead or infected children can be explained by the chorionic ferments absolutely destroying the granules formed by its spirillolytic action.

Colles's law is founded on the fact that women infected before or during the course of their pregnancy, cannot therefore be reinfected. As Sir F. W. Mott has said, "every syphilitic child has a syphilitic mother." If a woman is already syphilitic before her ovum is infected, her reaction will be positive and she cannot be reinfected by her child, during lactation or otherwise.

If the woman has a syphilitic husband who has infected the ovum at fertilization, she may become infected through the fœtus and become positive if the chorionic ferments fail to protect her from spirochætal infection. Or both she and the child may be protected during pregnancy by the chorionic ferments granulosing the mature organism, and both may remain negative till after the store of chorionic ferments are exhausted after parturition. In both of these groups the child, if alive after birth, could not infect the mother, but might infect another woman.

Difficulties in Diagnosis in Pregnant Women.—There is still a difficulty in diagnosis in cases where the mother's Wassermann reaction is negative, in the absence of reliable evidence of previous congenital syphilitic offspring, and of any history or evidence of syphilis in the mother.

Congenital Syphilis.—As Dr. T. H. C. Stevenson, Superintendent of Statistics to the Registrar-General, stated in his evidence before the Royal Commission on Venereal Disease in 1914: "The worthlessness of the returns in death certificates, as an absolute statement of the number of deaths from venereal disease, scarcely requires demonstration." "Venereal disease to a considerable extent is hidden under other items of the official classification, and infants' deaths returned under 'congenital debility' and other headings (such as 'marasmus,' 'infantile atrophy' and 'prematurity') are largely due to syphilis." I doubt if it is realized how frequently congenital syphilis occurs in our industrial cities. I will only quote one set of statistics given by Dr. Helen Campbell, Chief Medical Officer of the Infants' Department of the Bradford Health Committee, on the effects of congenital syphilis on infantile mortality in Bradford in 1918. Of 2,172 infants under observation in 1918, 1,606 were registered during the year, and of these 148 died, 107 out of the 1,441 legitimate children and 41 out of 165 illegitimate. Of these 148 infantile deaths, 120 were those of syphilitic infants, 81·08 per cent. of the total deaths. Of the 107 legitimate children who died, 83 (77·5 per cent.) had congenital syphilis, whilst out of the 41 illegitimate children who died, 37 (90·2 per cent.) had syphilis. Dr. Helen Campbell shows that these startling figures "are due to the fact that congenital syphilitic infants are peculiarly selected for attack by respiratory, gastro-intestinal and specific infections (e.g., measles) which kill them in much larger numbers than infants not so affected." The congenital syphilitic child with a positive Wassermann reaction is apparantly rarely cured, and Mr. Charles Gibbs told me in 1917 that he had never known a positive reaction in a congenital syphilitic child become negative after treatment. What then becomes of these children? Do 80 per cent. die during their first year of life as in Dr. Helen Campbell's cases? If so, prevention before birth is essential.

Treatment.—The treatment of syphilis in the pregnant woman has two objects in view—to cure the mother and to prevent her child being a congenital syphilitic. Treatment in my opinion is only likely to be successful if up to the date of its commencement the multiplication of the mature spirochæte has been prevented by the granulosing and inhibiting action of the ferments. For if unrestricted infection by the mature organism had been going on in the early cellular ovum or fœtus it would have been speedily destroyed, as every growing organ would have been invaded. The surgeons at the Female Lock Hospital, with such pioneers elsewhere as Mr. John Adams, Dr. Sequeira, Dr. Morna Rawlins and Dr. Hendry, with some variations in their methods of treatment, have had extremely good results, showing that children of syphilitic mothers can remain healthy for more than twelve months after their birth. This is a result which few of us have anticipated, and should encourage everyone working on the subject. I hope the discussion will show what advantages salvarsan or its substitutes have over the old or present mercury methods in the treatment of pregnant syphilitic women. Sir F. W. Mott has quoted O'Farrell and A. Balfour to show that injections of salvarsan cause shedding of granules from the *Spirochæta pallida*, and would thus, I suggest, increase the action of the ferments. If these granules are not destroyed but only rendered latent, clinical syphilis will follow, just as may occur after the action of chorionic ferments have ceased. Whatever the treatment may be, it should be adopted at the earliest possible moment, though cures appear to have followed when injections have been made in the later months. Four cases have been recorded by Dr. Morna Rawlins, in which successful treatment was begun at the seventh and eighth month. It would seem that this could only have occurred where spirillolysis, and inhibition of the granules, had occurred up to that date through the action of the chorionic ferments, or where partial or complete destruction of the granules had taken place before the injections were begun.

Treatment of Child after Birth.—The question also of the continued treatment of the new-born children of these syphilitic mothers, often with negative Wassermann reaction in the mother and child, needs consideration, for the modern treatment varies, some thinking that treatment during lactation may be still effected through the mother. If the child is treated separately after birth, the question also arises whether it should be treated by injections of galyl, or by mercury, which I think Dr. Morna Rawlins prefers, or iodide of potassium, as Dr. Macalister of Liverpool advises.

It is obvious that in many cases the father may need treatment also, and that the mother and the child should not be allowed to drift away, but should be seen occasionally for tests and for treatment where necessary.

The actual treatment of pregnant women infected by syphilis is now rarely carried out by obstetricians, but the principles of treatment and the frequent latency of syphilitic infection during gestation should be clearly realized both by general practitioners and specialists, for the mother's and child's welfare is in their hands.

I believe congenital syphilis could be prevented in all well-organized health centres, if every expectant mother came under scientific medical supervision, and if facilities for diagnosis and for both efficient and sufficiently prolonged treatment of mother and child were available. This is what the Ministry of Health is endeavouring to organize.

The Results of Antisyphilitic Treatment of Pregnant Women and New-born Infants.

By JOHN ADAMS, F.R.C.S.

TWO years ago I read a paper before this Section on the "Treatment of Ante-natal and Post-natal Syphilis." At that time I was only able to give the results of one year's treatment, but the table I now lay before you gives the full results of all cases treated during the past three years at the Thavies Inn Venereal Centre for Pregnant Women, as far as it has been possible to follow them up. I quote from my former paper: "I am aware that one year is too short a period in which to bring the treatment of ante-natal and post-natal syphilis to perfection and that the treatment adopted to-day will be improved on to-morrow." This statement has been fully confirmed during the past two years. I have been able to follow up most of the cases and, last November, I showed to the Fellows of the Hunterian Society many of the babies up to 2 years old, all of whom appeared perfectly healthy and showed a negative Wassermann test. On one occasion only did a baby show a doubtful positive Wassermann reaction after once becoming negative.

In each year the percentage of babies born with a negative Wassermann reaction has increased, as shown by the statistics which I have given. I attribute this result to the more active treatment the mothers receive before confinement, and the more general use of salvarsan in pregnant syphilitic women than formerly. I confidently look forward to seeing the wastage of infant life from syphilis reduced to a vanishing point. At present it is doubtful if any disease, even tuberculosis, is so destructive of child life or as disastrous to child health as syphilis.

Most of the mothers enter Thavies Inn at about the sixth month of pregnancy, having been sent there on a diagnosis of syphilis, made either on clinical evidence, or on the results of the Wassermann test. Some have been treated with mercury and arsenic and in consequence have no obvious lesions, others have had no treatment whatever. Practically all are in the secondary stage of the disease.

The results of treatment are most encouraging, though, of course, they vary with the period before confinement at which it is begun. In the last two years there has been only one stillbirth and no deaths from syphilis among the cases treated.

My experience has been that if the mother's Wassermann test can be converted to negative, or "doubtful" at her confinement the baby will be born negative and show no sign of syphilis. If the mother is positive or strongly positive the baby will probably be positive too, in which case, of course, vigorous antisyphilitic treatment is begun at once. However, in a case at present under my care, in which a definite history was obtainable that infection took place about seven months after conception, and no treatment was given before confinement, the baby was born negative, although at the time the mother had generalized syphilis as shown by a strongly positive Wassermann reaction. Cases of this kind open up interesting questions as to the cause of the baby's immunity.

None of the babies born negative have since become positive, nor developed any signs of syphilis, though many have not had any treatment beyond the drugs they absorb through their mother's milk.

To summarize, I may say that a pregnant woman with syphilis, whether active or latent, if treated for three or four months before her confinement, will probably be delivered of a healthy child at full term.

STATISTICS.

THAVIES INN VENEREAL CENTRE FOR PREGNANT WOMEN.

Result of Treatment of Women during Pregnancy and of the Newly-born Children.

Years September 1 to August 31	Mothers admitted with syphilis	Babies born alive Wassermann reaction		Babies dying of syphilis	Fœtus stillborn from syphilis
		Positive	Negative		
1917—1918	28	17	6	Three at the ages of 3, 14, 36 days respectively	Five
1918—1919	30	8	21	One 2 months	One
1919—1920	37	1	36	None	None

Treatment of Babies.

	Intramuscular Galyl in glucose	Intramuscular Hg	Oral Hg
1st day	1·5 cgm.	—	—
8th ,,	1·5 ,,	⅙ gr.	½ gr. daily.
15th ,,	—	—	Hyd. c̄ creta.
22nd ,,	2 cgm.	¼ gr.	,,
29th ,,	—	—	,,
36th ,,	2½ cgm.	¼ gr.	,,
	Wassermann test.		
43rd ,,	—	—	,,
50th ,,	2½ cgm.	⅓ gr.	,,
57th ,,	—	—	,,
64th ,,	3 cgm.	⅓ gr.	,,
71st ,,	—	—	,,
78th ,,	3 cgm.	⅓ gr.	,,

Wassermann test: Nearly all babies become negative before or at this period.

120th day	5 cgm.	½ gr.	Intermediate treatment.
134th ,,	5 cgm.	½ gr.	
176th ,,	Wassermann test.		

Should the Wassermann be definitely positive at any future time begin *de novo* with treatment.

Mr. CHARLES GIBBS said that as a worker at the London Lock Hospital, Harrow Road, for twenty-five years, in charge of women and children, he had always thought it a pity that this question of the treatment of syphilis in pregnant women had been grossly neglected until the last few years. It had been impossible for a poor woman suffering the double burden of pregnancy and the disease to be admitted into any hospital at all, except the infirmaries. At the Lock Hospital they had taken in a few cases, most of the women being sent to a neighbouring infirmary for their confinements, mother and child being returned to them for further treatment. During the last few years, the Ministry of Health through its venereal disease centres had provided the money for the hospital accommodation of some of these women, but the accommodation provided was very small in comparison with the large numbers requiring such treatment. It was supremely important to the State that proper facilities should be forthcoming for the treatment of this disease, which was responsible for so much infant mortality, for the results of the modern treatments of syphilis were most satisfactory and efficient with regard to the pregnant women and offspring. It was remarkable how little treatment by modern methods was required to reduce the percentage of dead, and to increase the percentage of living children born. Mr. Gibbs' experience in this work was divided into two periods—before and after the introduction of the Wassermann test and the "606" treatment. Dr. Hendry's statistics showed clearly the excellent results of treatment in the mother by mercury. Mr. Gibbs believed these results were obtained in out-patient work, and the figures showed excellent results with mercury and out patients. The results which they obtained at Harrow Road Hospital in the old days on mercury were very similar to these figures. The statistical records of the Harrow Road Hospital during this period similarly showed remarkably few deaths in the infant, but it was always recognized that the mother must undergo a prolonged period of mercurial treatment to produce an apparently healthy child. Before the introduction of the Wassermann test it had been extremely difficult to know what to do with the infants of syphilitic mothers born without blemish. Their method then had been to treat them as syphilitic—i.e., to give a three years' mercury course. In his earlier days at Harrow Road Hospital he remembered a surgeon who, finding no sign of syphilis, thought himself justified in leaving the children untreated. He saw his work for many years and in the vast majority of cases this surgeon was quite right, and no signs occurred though they remained in hospital so long a period as two years. So that they must be very careful to remember that an infant with no signs might never develop any signs even though it had received no treatment. In the second period all cases of syphilis, adult, child, or infant, who showed signs of syphilis or whose Wassermann reaction was positive had received a full course or multiple courses of "606" or substitute, and if a patient, adult or infant, again showed no signs of syphilis and a negative Wassermann, no "606" did he give until one or both of these facts changed. All patients were given a full two or three years' course of mercury, as he was positive that "606" does not cure syphilis. In regard to the after-histories of mothers and children, if the mother, and through her the child, had received "606" or a substitute, and if they had both received two or three years' mercury treatment, he believed that the majority of them would not suffer from syphilitic signs again. It was in private practice that they could follow up these facts best. His experience during the last twenty-five years had convinced him that after a sufficient course of mercury for three years, it was unnecessary for the woman to take further treatment and that she would produce apparently healthy children. Both women and children had been very grossly neglected in regard to this particular; women were notoriously bad attendants in private and at out-patients'; they would not take the necessary amount of treatment and the children were similarly neglected. Another point was the small amount of mercury given, a mild pill, or a grain of metallic mercury intramuscularly was not enough. Massive doses of mercury for prolonged periods were necessary to cure syphilis. He had known many women produce full broods of children after full courses of mercury. He had seen two examples this week. It was in the private practice of older men like himself that these facts were learnt.

They had used all forms of treatment for the newly-born child, as he had stated before; infants born without signs and negative Wassermann had received mercury only, three years' course, by mouth, by muscle, by inunction, by vein (as used in Mr. Lane's cases). All infants and children showing signs of syphilis had received "606" or substitute, by various methods—intravenously, intramuscularly, intrafascially, and by suppositories. They greatly preferred the intravenous method. It was extremely easily given to infants by the external jugular vein, or through the anterior fontanelle. The latter method for the giving of various serums and vaccines, he had seen recommended by a lady doctor in the *Lancet*, so he thought they might try the method for obtaining blood for the Wassermann and for giving "606." It was a very good method; they had had no accidents nor trouble with the method at all, owing largely to the skill of their present house-surgeon, Dr. Rundle. To his mind a very important point with regard to the treatment of the infants is to give the mother a full course of "606" after the birth of the child, during breast-feeding. The increase of weight of the child during this five or six weeks was surprising.

He would not care to express an opinion as to the inexplicable variations of the Wassermann tests, it was a surface tension reaction, of the biochemistry of which he had no knowledge. Younger surgeons with their knowledge of biochemistry would easily make that all clear.

He had collected the histories of the last 100 syphilitic pregnant women and their babies who had been discharged from the Lock Hospital, and had got out all the figures relating to them, as shown in the following Table:—

100 WOMEN, AGES 17-38 (MOSTLY 17-21).

All numbers are percentages.

Primiparæ.—75.

Syphilis.—Primary, 7; secondary, 87; tertiary, 1; no signs, 5.

Time of infection.—Before pregnancy, 8; at pregnancy, 65; first three months, 9; second three months, 11; third three months, 7.

Treatment.—"606" full course + mercury, 90.

Wassermann test.—Before "606," 84+; after "606," 14+; at birth of child, 66−.

INFANTS.

Born at full term, 85; eight months, 3; seven months, 8; abortions, 4.

Condition at birth.—Normal, 86; syphilitic signs, 5; wizened, 5; 4 of these jaundice.

Treatment.—Mercury and "606."

Weight.—91 gained.

Wassermann test.—97 per cent. living children negative; 3+ at birth soon became negative.

Results.—Abortions, 4; stillborn, 4; died in twenty-four hours, 3. 11 dead; 91 living.

In regard to the fact that practically all the children were negative, this obviously could not be explained by the children being free from syphilis or the syphilis being rendered latent by treatment. There must be some natural physiological cause for this practically total negative result. The only theory which seemed to meet these facts was that propounded by Dr. Routh, of placental ferments, and some institution where such a theory could be practically tested, was desirable. At the present time Roux was doing some experimental work on placentæ in this particular, and was using fluid compressed from the placenta in the cultivation of spirochætes.

Mr. J. E. R. McDonagh said that once a woman was syphilitic she required treatment throughout each succeeding pregnancy irrespective of the amount she had had before, and even if the father of the later children had never had syphilis, if no stone was to be left unturned to produce an apparently healthy child. Women who were pregnant and contracted syphilis in the ordinary way behaved like those who were not pregnant so far as the course run by the disease and blood tests were concerned, although as time went on if repeated pregnancies occurred the disease seemed to be rendered milder and the complement-fixation test became negative. It was possible that repeated pregnancies might result in the spontaneous cure of the disease, although there was usually the tendency for the symptoms to relapse and for the blood to become positive again after the child-bearing period was over. More interesting were those cases which showed symptoms for the first time at the menopause—cases of conceptional syphilis. These cases could not be diagnosed during the child-bearing period until an infant had been born, which proved what had happened, or unless symptoms occurred earlier, which they might do if a long interval had elapsed since the last pregnancy. These cases were not only symptom-free but the complement-fixation test might be negative as well. In his experience conceptional syphilis was on the increase and was most likely to occur in those instances in which the husband had had one or two courses only of arseno-benzene and mercury and was allowed to marry because his complement-fixation test was temporarily negative. The most important question arising out of ante-natal treatment was that relating to the infectivity of the child. Treatment of the mother in most instances resulted in the birth of a healthy looking baby whose blood was almost invariably negative. Were those children syphilitic? and, if so, would the treatment for the two to three years advised prevent the appearance of symptoms in later life? Not sufficient time had elapsed to enable him to answer those questions with any degree of certainty; this was true especially of the second. He thought that the children were syphilitic, and he always treated his cases as if they had actually shown signs of the disease, because he had seen plenty of cases of syphilis hereditaria tarda develop in those not so treated. But it was to be seen whether treatment would prevent these late manifestations. Another very interesting point was the risk the infant ran of becoming infected if the mother contracted syphilis while the child was still *in utero*. In his experience the infant was bound to become infected if the disease was contracted by the mother any time before the end of the fifth month. During the sixth and seventh months roughly half did and half did not become infected, but any time after this the child escaped. This matter was important because great success was resulting from the treatment of the mother while she was suckling her syphilitic infant. But in no circumstances should this be allowed if the disease was contracted by the mother late in pregnancy, as the infant ran the risk of contracting acquired syphilis. There were quite a number of so-called congenital syphilitics which were really cases of acquired syphilis. Modern treatment had done wonders in syphilis of the mother and child, but they must only regard it as an adjunct to the treatment handed down by eminent clinicians of the past and never as a supplanter of the two to three years' course.

Mr. EARDLEY HOLLAND, discussing syphilis as a cause of fœtal death, said that no one had yet spoken on the frequency of syphilis as a complication of pregnancy, and he felt sure it had been greatly exaggerated—e.g., the Royal Commission on Venereal Diseases came to the almost ludicrous conclusion that 50 per cent. of stillbirths were due to syphilis. This figure was greatly at variance with the figures obtained by all recent workers. He had personally investigated in great detail the cause of fœtal death in a mixed sample obtained in London of 300 dead-born viable fœtuses, of which 133 were macerated and 167 were born in a fresh condition. The investigation consisted in a complete histological examination of the fœtal organs and of the placenta, the *Spirochæta pallida* being looked for both by the direct and by the Levaditi methods. The health of the mother was also investigated, including the result of her Wassermann reaction. Where possible, the father was also investigated, but he proved a very elusive person. Spirochætes were found in thirty-seven of these fœtuses, or 12 per cent. of the whole, thirty-five of them being macerated and two fresh. These were cases of undoubted fœtal syphilis, and might be termed cases of active or florid fœtal syphilis, as opposed to possible latent fœtal syphilis, where spirochætes could not be found. An important question arose as to whether these thirty-seven represented all the cases of fœtal syphilis in the series of 300; in other words, could fœtal syphilis be justifiably diagnosed in the absence of spirochætes? He believed it could, and the method of doing so was of great importance. Accepting the presence of spirochætes as the primary attribute of syphilis, he noted these special changes in the thirty-seven spirochæte positive fœtuses which could be called secondary attributes. They were as follows: Positive maternal Wassermann reaction in 100 per cent., chondro-epiphysitis in 100 per cent.; great enlargement of the spleen in 78 per cent.; great enlargement of the liver in 60 per cent., and placental changes peculiar to syphilis in 65 per cent. The remaining 267 spirochæte-free fœtuses were searched for these attributes. To begin with, the Wassermann reaction was positive in the mother in twenty-one, of which thirteen were macerated and eight were fresh. He concluded that syphilis could be justifiably diagnosed in four of these, for they contained a combination of the secondary attributes as follows (the maternal Wassermann reaction being positive in all): (1) chondro-epiphysitis, typical placental changes and enlarged spleen; (2) chondro-epiphysitis and typical placental changes; (3) typical placental changes and enlarged spleen; (4) chondro-epiphysitis and enlarged spleen. He believed the combination of these findings allowed of the justifiable diagnosis of fœtal syphilis in the absence of the *Spirochæta pallida*. Chondro-epiphysitis alone was sufficient, as it was absolutely pathognomonic of syphilis. He did not regard maternal positive Wassermann reaction alone in the absence of other changes as sufficient, nor of course did he believe that the mere presence of enlarged spleen and enlarged liver was sufficient, as these organs were found enlarged in so many fœtuses dead from other causes. Nevertheless he classed seven other fœtuses as "probable syphilis." They showed a combination of a positive maternal Wassermann reaction and enlargement of the liver and spleen. As regards the latency of the syphilis in the mothers of the thirty-seven spirochæte-positive fœtuses, active signs or a personal history of syphilis were obtainable in only six : in the remainder there were no signs of the disease, nor was any history to be obtained, even after the most searching inquiry. Quite apart from the latency of syphilis in the mother, the latency of syphilis in the fœtus was an important point to consider, and he had already referred to it. It was of special importance in view of the fact that in about 20 per cent. of the macerated fœtuses he was unable to discover the cause of death, and had to class them under "cause unknown." The difficulties of this aspect of the subject were well illustrated by the following case. A certain patient was sent to his ante-natal clinic because she had given birth to a macerated fœtus, two years previously. She attended for the last six months of her pregnancy, and on four different occasions her Wassermann reaction was found negative, nor had she any signs of other disease. She gave birth at the thirty-sixth week of pregnancy to a macerated fœtus ; investigation of the fœtus and placenta showed a complete absence of all the signs of syphilis, and he classed the fœtus under "cause of death unknown." Quite by accident he discovered that this patient had been treated for acute syphilis eighteen months before she became pregnant, and that her Wassermann reaction had first become negative six months before she became pregnant. The important question arose—was the fœtal death due to syphilis, and was this a case of latent syphilis in the fœtus? Other similar cases had come to his knowledge since this one. It raised a very important question as to whether certain macerated fœtuses, in which no cause of death was discoverable, had died from syphilis? If so, in what way had the disease acted in killing the fœtus? This part of the question was one which called for further investigation, and might reduce the large class of "causes of death unknown" in macerated fœtuses, and increase the class in which death was due to syphilis. It also showed the great importance of knowing precisely the state of health of the patient for a considerable period anterior to pregnancy.

Mr. KENNETH WALKER said that Dr. Amand Routh's theory of the pathology of latent syphilis in pregnancy was most interesting. It was possible to accept much of what Dr. Amand Routh had put forward, but with necesssary reservations. The evidence that the organism of syphilis might exist in some other form than a spirochæte was overwhelming. When they failed to discover spirochætes in the semen of a syphilitic subject and yet knew from the clinical and experimental evidence that such semen was infective, the only conclusion possible was that syphilis existed in a form other than that of a spirochæte. The same remark might apply to the fœtus and might explain the failure to find spirochætes in syphilitic miscarriages. After a certain period these spores or granules would develop into the spirochæte which was found so readily in the tissues of the syphilitic stillborn child. Whether the chorionic ferments had any action on the organism of syphilis was quite a different question. It seemed to him that Dr. Amand Routh, anxious for the safety of the developing child surrounded by all the horrors of spores and spirochætes, had finally decided that the chorionic ferments must play the rôle of the good fairy. There was no direct evidence that chorionic ferments acted in this way. As the spirochæte could now be grown in culture it would surely be possible to test the action of chorionic ferments on spirochætes. The protective agency in question was more likely to be due to lipoids of the placenta. It was difficult to obtain reliable statistics as to the frequency with which a negative Wassermann was obtained in syphilis in pregnancy. Out of 226 women attending a Buenos Ayres Maternity Clinic and exhibiting clinical signs suspicious of syphilis, 116 had given a negative Wassermann; it was however difficult to be sure that all of these suspicious cases were actually syphilitic.

Mr. ULYSSES WILLIAMS said that he had been recently making an X-ray examination of stillborn fœtuses, and had found, in a certain proportion, evidence of chondro-epiphysitis. Although the number so far examined (about fifty) was far too small to form an accurate basis for the calculation of percentages, he had estimated provisionally that 12 to 15 per cent. showed changes in the ends of the diaphyses, which might be attributed to syphilitic infection.

Dr. HENDRY (in reply) pointed out that the cases brought forward by Mr. Adams and Mr. Gibbs were of active syphilis and presented different problems, especially in diagnosis. He agreed with Dr. Holland that the chondro-epiphysitis, when fully developed, was characteristic of syphilis, but he had seen cases in which the epiphyses presented irregularities and no other evidence of syphilis could be found. In a few cases of chondro-epiphysitis which had been X-rayed there were definite changes. The firmness of the cranial contents in the syphilitic macerated stillbirth contrasted with the diffluent cranial contents in the non-syphilitic. In view of Dr. Routh's suggestion of the negative Wassermann in a syphilitic pregnant woman he called attention to the case Mr. in Table I (p. 214) where, following three surviving infants, three stillbirths occurred; only the last two were examined—both were positive and there could be little doubt that the first was also syphilitic. Nevertheless during the third pregnancy ending in stillbirth the Wassermann reaction was negative at six months and positive four days after labour.

Dr. AMAND ROUTH (in reply) was glad that several speakers had thought his suggestion might prove to be justified. He agreed with Dr. Hendry that most of the cases described by Mr. John Adams and Mr. Charles Gibbs were cases of primary or secondary syphilis, unlike Dr. Hendry's cases, yet the infection became latent, and under treatment healthy children were born. Mr. Eardley Holland's views as to the incidence of congenital syphilis were too optimistic. As Dr. Hendry had pointed out Mr. Holland in 1914 had found spirochætes in six out of the first seven stillborn fœtuses examined, and in twelve out of the next eighteen cases. The fact that he had not been able to find spirochætes in more recent examinations in more than 12·5 per cent. of stillbirths did not prove that more of the stillborn children had not died of syphilis, but tended to confirm his suggestion that infection might be caused by less mature stages of spirochætal development. The estimate that at least 20 per cent. of the ante-natal and neo-natal deaths were due to congenital syphilis did not appear to be overstated and, if so, it meant that about 27,000 deaths from syphilis took place between conception and the fourth week after birth. Dr. Hendry had noticed that untreated syphilitic mothers after several stillbirths had sometimes had eventually healthy children; Dr. Routh had alluded to these as due to the mother after several rapidly recurring pregnancies being so saturated with chorionic ferments, and maternal antibodies, that the spirochætes were not only granulosed but destroyed. Mr. Kenneth Walker had suggested that it would be easy to determine *in vitro* the power of chorionic ferments to granulose spirochætes. Unfortunately no one had been able to isolate these ferments or to establish their chemical constitution, though Abderhalden had been enabled to determine their presence by chemical reactions. The good results of treatment in the three series of cases of Dr. Hendry, Mr. John Adams and Mr. Gibbs were almost startling, and would encourage workers to realize that the mother was able to be cured, and the offspring prevented from becoming congenital syphilitics.

Section of Obstetrics and Gynæcology.

President—Mr. Henry Briggs, F.R.C.S.

(?) Fibrosarcoma removed from the Hollow of the Sacrum.[1]

By Douglas Drew, F.R.C.S.

The woman was aged 37. The first confinement, fourteen years previously, was difficult and instrumental and the medical attendant noted some slight narrowing of the pelvis. Six years later during the second pregnancy, the pelvis was found to be narrowed by the tumour. Labour was induced at the thirty-second week and the child survived. During the last seven years the tumour had increased very little, but it had given rise to chronic pelvic pain, and pain on defæcation.

Per rectum a hard and very tender mass could be felt which was firmly fixed. Skiagrams showed nothing abnormal.

At the operation in May, 1920, the tumour projected on the right side of the rectum. It was about the size and shape of a small kidney, the upper end was at the level of the first right sacral foramen. The internal iliac artery and ureter were to the outer side. Although encapsuled it was very intimately adherent to the tissues in front of sacrum.

Mr. Leonard Phillips, Registrar at the Hospital for Women, makes the following report: On section the tumour showed (1) a glairy mucoid-like surface; (2) patches of hæmorrhage and necrosis, the latter almost caseous; (3) a central cystic space about 1 in. in diameter. Microscopically, the structure is a fibrosarcoma with a cellular stroma. The cellular structure of the stroma suggested malignancy, although the slow rate of growth and encapsulation do not coincide with this appearance.

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[1] At a meeting of the Section, held October 7, 1920.

REPORT OF THE PATHOLOGY COMMITTEE ON MR. DOUGLAS DREW'S CASE.[1]

Mr. Douglas Drew's specimen of "Fibrosarcoma removed from the Hollow of the Sacrum" was examined, and the Committee reported as follows:—

"We have examined this specimen and have come to the conclusion that it is a tumour composed of fibrous and muscular tissue undergoing an unusual form of degeneration. It contains peculiar areas or loculi filled with swollen vacuolated cells having small nuclei. We think these cells may be lymphocytes or shed endothelial cells. We see no reason to believe that it is a sarcoma, nor a tumour of adrenal origin."

Sodium Bicarbonate Tolerance in the Toxæmias of Pregnancy.[2]

By CLIFFORD WHITE, F.R.C.S.

THE object of this communication is to bring before the members of this Section the applicability to the toxæmias of pregnancy of Sellard's work on acidosis.

Acidosis is seen in a pronounced form in diabetes and since the discovery of β-oxybutyric acid and aceto-acetic acid in the urine of these patients, it seems sometimes to be thought that acids are circulating in the blood. This is not the case, as, even in the most extreme cases of acidosis, death occurs before any gross alteration takes place in the reaction of the blood, which, normally, is slightly alkaline from the presence of protein and of carbonates and phosphates. This alkalinity is maintained in spite of the fact that on a mixed diet there is a production of acid bodies from the metabolism of carbon, phosphorus and sulphur. This tendency to acid formation is corrected both in health and disease by (1) oxidation, (2) excretion and (3) neutralization.

(1) *Oxidation.*—Carbon is oxidized and then excreted as CO_2 by the lungs and as urea by the kidney.

(2) *Excretion.*—In addition to getting rid of the products of partial or complete oxidation, the kidneys maintain equilibrium by their property of excreting a normally acid urine from a normally alkaline blood serum. This is done largely by the excretion of acid phosphates

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[1] Presented at a meeting of the Section, held December 2, 1920.

[2] At a meeting of the Section, held December 2, 1920.

such as NaH_2PO_4. But it will be noted that, before excretion, alkaline bases, such as sodium, are required to combine with these acid bodies.

(3) *Neutralization.*—This may be effected by (*a*) the fixed bases of the food or (*b*) by ammonia. Most of the ammonia excreted in the urine is for the purpose of neutralizing acids; this is shown by the fact that giving large doses of sodium bicarbonate by the mouth will reduce the ammonia percentage to 0·5 per cent. of the total urinary nitrogen. Normally 2 per cent. to 5 per cent. of the total nitrogen in the urine is used to neutralize acids; in acidosis the percentage thus used may rise to 40. If the increase in ammonia is due to a defect in the protein metabolism and not to an acidosis, it will be unaffected by sodium bicarbonate feeding.

It will thus be seen that a fixed base such a sodium is required to carry CO_2 to the lungs and also to enable the kidney to excrete acids. Failing the fixed base, the kidney does use ammonia to enable it to continue working, but if the sodium is depleted, CO_2 cannot be carried to the lungs although oxygen is carried to the tissues—hence the dyspnœa without cyanosis that occurs in some cases of acidosis such as that seen in diabetes. Thus one finds that the essential of acidosis is the depletion of the alkaline bases.

In health, the taking of 5 grm. of sodium bicarbonate by the mouth is followed by some being excreted at once, as the tissues have already got their full complement, hence urine alkaline to litmus is excreted within a few hours. In disease, if the alkalies are depleted, any excess of sodium ingested goes into store in the tissues, and so the urine remains acid after more than 5 grm. of sodium bicarbonate have been taken by the mouth. It has been pointed out that one of the proofs that it goes into store is that once the urine has been made alkaline by a big dose and then again becomes acid, it can once more be made alkaline by a small dose in most cases. In diabetic patients the effect of the initial big dose is rapidly lost.

Sellards, working on cases of nephritis following Asiatic cholera, proved that sodium bicarbonate, when injected in large doses into a patient with acidosis, (1) was not excreted by the intestine in quantity; (2) did not accumulate in excess in the blood; and (3) could be excreted freely by a diseased kidney. He concluded that a tolerance to over 10 grm. of sodium bicarbonate without the urine becoming alkaline forms a test for the presence of acidosis, which he defines as "an impoverishment of the blood and other tissues in fixed bases or in substances which readily give rise to fixed bases."

To see the clinical value of this test, it is useful to enumerate the other methods by which the existence of acidosis has been demonstrated. These may be divided into laboratory tests and clinical signs.

LABORATORY METHODS.

(1) *Examination of the Alveolar Air for lowering of the* CO_2 *Tension.*—This is not especially difficult with the proper apparatus, but the tension is also lowered in cardiac and pulmonary diseases.

(2) (A) *Examination of the Blood for lowered* CO_2 *Tension.*—This gives practically the same result as (1 but is more difficult.

(B) *Examination of the Blood for lowered Alkalinity.*—(*a*) By titration with phenol-phthalein after removal of the protein or (*b*) physico-chemically by measuring the increase of the hydrogen-ion content.

Neither of these methods is really satisfactory, as Nature keeps the blood reaction nearly constant at the expense of the reserve of alkalies, and no change in the hydrogen-ion content is demonstrable till the patient is moribund.

(3) *Examination of the Urine.*—(*a*) For excess of Na, K, Ca and Mg salts of the normal and abnormal acids; (*b*) other changes in the fixed bases; (*c*) increase in ammonia. All these involve chemical analysis and are not wholly reliable; for example, increase in ammonia occurs in cases of faulty protein metabolism and acetone, &c., in simple starvation.

CLINICAL SIGNS.

(4) *Dyspnœa characterized by Deep Respiration with Prolonged Expiration without Cyanosis.*—This is only seen in very advanced cases.

(5) *The Presence of a Fruity Smell in the Patient's Breath.*—This is chiefly seen in cases of faulty carbohydrate metabolism.

(6) *Increased tolerance to Sodium Bicarbonate.*

Of the above six methods it seems that the bicarbonate test is demonstrable earlier even than the alveolar air test, and much sooner than the others become positive. Hence it appears that by the simple process of bicarbonate feeding we are able to prove the presence of acidosis sooner and more surely than by the most elaborate physico-chemical methods of the laboratory.

Now the question arises as to how far the above facts can be usefully applied to the conditions that come before us in connexion with the toxæmias of pregnancy. Sellards appears to have paid but little attention to such cases, as he worked almost entirely on nephritis and diabetes.

As pregnancy toxæmias are commonly associated with more or less marked nephritis, it is important to note that uncomplicated cases of parenchymatous nephritis usually have a bicarbonate tolerance of under 10 grm. Therefore from a rough clinical point of view it may be taken that, in a case of pregnancy toxæmia with a large bicarbonate tolerance, 10 grm. may be deducted as possibly due to the nephritis, and the rest will represent about the measure of the acidosis due to coexisting lesions.

I have been interested in the subject of sodium bicarbonate in acidosis since the recovery of a patient apparently in diabetic coma, after an intravenous injection of a solution containing 20 dr. of bicarbonate. Subsequently I have used it in most forms of pregnancy toxæmia as a method of treatment, but it is only in the last year that I have employed Sellards' method as a means of diagnosis and prognosis. The crude simplicity of the method is so extreme that one instinctively feels that there must be something wrong with it, but so far as my present experience goes, it has apparently been a valuable guide.

The patient is given measured quantities of sodium bicarbonate at fixed intervals and her urine tested by litmus paper before each dose is given. The amount given when the litmus is first turned blue is noted, and further doses stopped till the urine is again acid. If there is ammoniacal cystitis the urine should be boiled in a test tube to drive off ammonia before testing or, less accurately, the litmus paper itself may be heated. I have found it safer to order it in drachm doses (as nurses are liable to make mistakes when working in grammes) and have usually given 1 dr. in water every three or four hours. No gastric disturbances have been complained of.

The patients in some fifty toxæmic cases of various kinds have had their tolerance tried, but on going into the notes, I found that most of the cases were useless to record, as, in addition to the fixed doses of bicarbonate, the patients had been given an indefinite quantity in barley-water to drink. The cases have therefore not been recorded.

The following cases admitted to Queen Charlotte's Hospital have been under the observation of Dr. A. G. Howson, Senior Resident Medical Officer. The endeavour has been made to exclude patients who merely suffered from a transient albuminuria during labour and to include only those who had albuminuria before labour, or other symptoms as well. It will be seen that the average quantity taken by the mouth (and exclusive of any given *per rectum* and intravenously) in fifteen cases is 45·3 grm.

For purposes of comparison thirteen normal cases were observed and their urine was alkaline after an average of 6·8 grm. We thus get the result that the average bicarbonate tolerance of patients clinically suffering from pregnancy toxæmias is 45·3 grm., compared with the average bicarbonate tolerance of 6·8 grm. in puerperal cases not suffering clinically from toxæmia. Further, the fatal case had a tolerance of no less than 120 grm., compared with an average tolerance of 40 grm. on the part of those that recovered.

If a rough attempt is made to gauge the severity of the clinical manifestations by the method of treatment adopted, it will be found that the average tolerance of those on whom it was thought necessary to perform Cæsarean section on induction was 61·7 grm., compared with 33 grm. in those who were allowed to deliver themselves, with or without the aid of forceps.

Three cases in the table are marked "nephritis." This indicates that the state of the retina, the character of the urine, or the history made it probable that albuminuria existed before pregnancy, although the more urgent symptoms only appeared before labour. It will be seen that their average tolerance is 23 grm., or lower than the primarily toxæmic cases.

One other case may be given more fully. In August, 1920, I saw a patient with severe vomiting and albuminuria at the sixth month of pregnancy. The vomiting was incessant, even of peptonized milk, and continued in spite of her removal to a Home. She was extremely ill, but had not the usual appearance or mental state of a pregnancy toxæmia patient, so I postponed interference and tried her bicarbonate tolerance. Her urine became strongly alkaline after 12 grm. had been taken, so it was again decided to watch for her a little longer. Two days later symptoms of bulbar paralysis appeared, which a neurologist diagnosed as of alcoholic origin, and it soon became obvious that she was suffering from acute alcoholic gastritis and nephritis. But for the aid given by the bicarbonate test, it is probable that the case would have been regarded as one of pernicious vomiting with albuminuria.

It seems to me that by testing the tolerance to bicarbonate of soda in patients suffering from what is thought to be a toxæmia of pregnancy we have a method that is extremely simple and harmless. Further experience will prove whether it is of great or little value. The fact that it does not seem to have been generally tried on a large scale is my reason for bringing such a simple subject before the Section.

Number	Parity	Clinical type	Method of delivery	Acetone or diacetic acid	Result	Amount of sodium bicarbonate given by mouth before urine alkaline, in grammes
1	M_4	Albuminuria	Normal	—	Recovery	32 (plus 48 in previous three days)
2	P	Eclampsia	Cæsarean	?	Recovery	64 (plus rectal glucose and bicarbonate injections)
3	M_3	Eclampsia	de Ribes' bag	+	Recovery	40
4	P	Albuminuria	Cæsarean	—	Recovery	36
5	P	Chronic nephritis	Cæsarean	+	Recovery	28
6	P	Albuminuria	Cæsarean	+	Died (pericarditis)	120
7	P	Albuminuria	Normal	?	Recovery	16
8	P	Albuminuria	Induction	+	Recovery	72 (still acid)
9	P	Albuminuria	Normal	—	Recovery	32
10	P	Albuminuria	Forceps	+	Recovery	80
11	P	Albuminuria	Forceps	+	Recovery	48
12	M_1	Chronic nephritis	Normal	—	Recovery	28
13	M_1	Eclampsia	Cæsarean	+	Recovery	72 (plus 8 gr. intravenously)
14	M_1	Chronic nephritis	Discharged undelivered	—	Recovery	12 (subsequent normal delivery)
15	P	Albuminuria	Forceps	+	Recovery	16
					Average ...	45·3

TREATMENT.

A brief summary of the treatment of patients suffering from acidosis may be added. Carbohydrate food is of the greatest value and so these patients should not be put on a strict milk diet. An ounce of glucose may be given daily by the mouth or *per rectum*. A 2 per cent. solution of glucose has also been used intravenously. Laxatives are usually required. The deficiency in the fixed bases must be made up and I have found Langdon Brown's mixture useful. It consists of 1 dr. of sod. bicarb., ½ dr. of pot. cit., and 5 gr. each of mag. carb. and calcium chloride given three times daily. Syrup of orange or other flavouring may be added as the mixture is rather unpleasant to taste. In more severe cases, bicarbonate may be given in drachm doses every three hours and rectal salines should contain bicarbonate instead of sodium chlorine. It should be stopped when the urine remains alkaline. In urgent cases, 6 dr. of bicarbonate in a pint of water may be injected into the veins and repeated every six hours while the urine remains acid. In sterilizing a solution for intravenous use, it should not be boiled for more than ten minutes as sodium carbonate and hydrate tend to form. This occurs least if narrow-necked bottles are used, filled almost to the top and stoppered soon after boiling if the solution is not to be used immediately.

If an anæsthetic be required, chloroform should not be used as its administration in apparently healthy subjects is occasionally followed by symptoms of acidosis.

Dr. LAPTHORN SMITH said he felt quite sure that the value of bicarbonate of soda in the toxæmias of pregnancy was under-estimated. He had never given such large doses as the reader of the paper, who gave as much as 1 oz. a day until the urine became alkaline. He had for many years given about 100 gr. a day. Whatever the poison was it was an acid and could be dissolved by bicarbonate of soda and other alkalies and washed out of the system with distilled, or even rain water or tap water. If Mr. Clifford White's paper proved the means of drawing the attention of the whole profession to the importance of large doses of this simple drug in the toxæmias of pregnancy he would deserve the thanks of the many women whose lives would probably be saved.

The Necessity for the Reduction of Blood-pressure in Eclampsia.

By Major C. A. F. HINGSTON, O.B.E., I.M.S.

(Professor of Midwifery, Medical College, Madras.)

IT has been my privilege to work for the last twelve years in the Government Maternity Hospital, Madras (the largest gynæcological and maternity clinic in the British Empire outside the British Isles), and to be the senior medical officer of that institution for the last six years. The senior medical officer is resident and can see his patients and advise at all times of the day and night. Over 2,500 women are confined in this hospital every year, with an average of thirty cases of eclampsia every year (a somewhat high percentage). Three years ago, Colonel Gifford, I.M.S. (the late senior medical officer, now consulting physician to the hospital), and I became convinced of the following facts:—

(1) That high blood-pressure in eclampsia is a most serious complication and that it occurs in most cases of eclampsia.

(2) The necessity for keeping down the blood-pressure to 120 mm. or less, in all cases of eclampsia whether the patient is in a conscious or unconscious state, and in all cases in labour with premonitory symptoms of eclampsia.

(3) That the blood-pressure rises after delivery in a certain number of cases in patients who have shown symptoms of eclampsia up to the time of, or during delivery, and in cases in which no signs or symptoms have manifested themselves before and during delivery.

(4) That it is most necessary to watch all cases after delivery and reduce the blood-pressure to 120 mm. whenever it rises above that, after delivery.

(5) That the best way to reduce high blood-pressure in patients in labour with premonitory symptoms of eclampsia, is by venesection.

(6) That when called to see a case of eclampsia with high blood-pressure, if the patient is in labour, but the os is less than four-fifths dilated, the practitioner should reduce the blood-pressure to 120 mm. by venesection and keep it down by repeated venesection if necessary until the soft parts are sufficiently dilated for instrumental delivery.

(7) In cases in which the blood-pressure is about 120 mm. with the os four-fifths dilated, immediate instrumental delivery will reduce the blood-pressure.

(8) In cases after delivery in which the blood-pressure rises above 120 mm. reduce at once by venesection.

We decided that all eclampsia cases from October, 1917, to October, 1919, should be treated on the above lines so that we should have a series of cases and so be able to compare our results with other treatment previously adopted in the hospital and other treatment laid down in text-books and tried in this clinic. We unhesitatingly say that the results obtained from 1917 to 1919 are far better than in previous years, when other methods of treatment were adopted. Sixty-four cases of eclampsia were admitted from October, 1917, to October, 1919, and were dealt with in the following way: There were fifty-one cases with increased blood-pressure treated by venesection.

Result to mother.—Women, 51; recovered, 45; died, 6 (5 admitted with œdema of the lungs; 1 shock—adherent placenta—embolism twenty-four hours after delivery).

Children born.—Alive, 21; dead, 30 (several macerated and premature).

Venesection not required in 7 cases with high blood-pressure, because on admission to hospital the os was four-fifths dilated; immediate instrumental delivery reduced the blood-pressure.

Result.—Women recovered, 7; died, 0; children born alive, 6; child born dead, 1; 3 women admitted moribund with marked lung symptoms, no treatment possible, died very soon after admission; 3 with no rise of blood-pressure—all mothers recovered—all children born alive—venesection not required.

The patients in some of our cases treated by venesection were extremely ill: one woman had 23 fits, two 22, one 19, one 18, two 17, three 15, and the remainder 10 or less. A number of these fits outside the hospital before admission and before venesection was done. One woman was 87 hours in an eclamptic state, four were 48 hours, eight over 30, nine over 25, five over 15, and the rest 12 hours and under. Several of these were unconscious for several hours. Out of our 64 cases, 43 were primiparæ, 21 multiparæ. In one case the eclamptic fits occurred as late as the tenth pregnancy. The urine was found to be free from albumin in 14 cases (a high percentage). In 18 of the 51 cases, forceps were applied as soon as the os was at least four-fifths dilated—in one case the breech was extracted as soon as the soft parts were sufficiently dilated.

In all the 64 cases the blood-pressure fell after delivery; cessation or diminution in the number of fits occurred in the majority of cases after delivery.

In 17 patients of our 64 cases, the delivery of the child naturally or by forceps seems to have had no effect in preventing fits or diminishing the frequency of the fits in some cases. The blood-pressure of these 17 women continued to rise after delivery, the rise being preceded by a short fall, immediately following delivery. In five of these cases fits commenced only after delivery. It is therefore most necessary to watch the patient after delivery, and to bleed again when necessary. Recent experience at this clinic seems to prove that bleeding prevents further fits and prevents rises in temperature in a large number of cases, and that it prevents œdema of the lungs. No patient developed œdema of the lungs or less severe lung complications after having been bled. Many patients pass from an unconscious state to a conscious state, and then from a drowsy state to one far less drowsy, and they are certainly in a less irritable condition. The temperature was taken frequently and reduced when above 100° F. by iced enema, only required in a few cases.

The blood-pressure was taken every hour, and if found high, reduced by venesection to 120 mm. If it again rose, we reduced it to 100 mm. as a rule. In one case, at the second time of bleeding the patient, we reduced the blood-pressure to 85 mm., without any ill effect to mother or child. In the majority of our eclampsia cases, the blood-pressure was very high, the highest being 170 mm., and 2½ pints of blood were drawn off one woman with 140 mm. blood-pressure, before we were able to reduce the blood-pressure to 120 mm.

Venesection had to be repeated in some cases: 39 were bled once, 11 bled twice (all these 11 recovered), and 1 three times (she also recovered). We do not advocate *accouchement forcé*, neither do we think Cæsarean section advisable. The advocates of these methods have, no doubt, saved the lives of women who might have died, because by the hæmorrhage resulting from their treatment they have reduced the blood-pressure of their patients and have prevented lung complications, probably the shock following prevented further rises in blood-pressure after delivery. We prefer to reduce the blood-pressure by venesection and to deliver as soon as the parts are sufficiently dilated to ensure an easy delivery without damage to the woman. We do not fear undue emphasis being laid upon venesection as a remedy. We are certain that the risk of death cannot conceivably be increased by venesection. Heart failure in eclampsia is due to high blood-pressure and not low blood-pressure; the heart in every case is relieved when the high blood-pressure falls owing to venesection.

In addition to the reduction of blood-pressure and to watching the temperature, we follow the usual practice of giving no food by the mouth, emptying the lower bowel if the patient is constipated; morphia is given, the patient is kept in a quiet and darkened room, and in some cases we wash out the stomach if the patient has had a big meal before coming to the hospital. We only give saline when we find the specific gravity of the patient's blood over 1055, and after we have bled patients if the blood-pressure rises above 120 mm.; only two of our cases required saline.

So convinced are we of the necessity for the reduction of blood-pressure by venesection in eclampsia, that I have made this short communication, and hope that in the future the great teachers in midwifery will in their text-books impress upon the student and practitioner the great importance of this reduction of blood-pressure.

DISCUSSION.

Dr. DONALDSON said he held the opinion that the high blood-pressure in eclampsia and other toxæmias of pregnancy was a protective mechanism to help secretion from the kidneys, and could not therefore agree with the principle of lowering it by venesection, &c. If the origin of the toxin was the placenta, or some part of the ovum, the logical treatment was to get rid of this source as quickly as possible. The best way of doing this in the later months of pregnancy was by means of Cæsarean section.

Mr. ALICK BOURNE, while fully realizing the importance of reducing the blood-pressure in eclampsia, was doubtful as to venesection being the best method for this purpose. He could not agree that a sufficient reduction could be produced by venesection in the majority of cases without danger to the patient, and thought that a far better method to employ was the hypodermic injection of veratrone in doses graduated according to the height of the blood-pressure. Veratrone produced remarkable reductions, particularly if the tension was very high, and, though its effect was short-lived, the injection could be repeated on a subsequent rise without ill effects.

Mr. GORDON LUKER said he was entirely in agreement with Major Hingston as to the value of venesection in the treatment of eclampsia, especially if followed by intravenous infusion of saline. This infusion after bleeding caused only a temporary rise of blood-pressure, and this was followed by diuresis, diaphoresis, and a fall of blood-pressure.

Case of Concealed Accidental Hæmorrhage with Eclampsia.

By W. FORDYCE, M.D., F.R.C.P., and R. W. JOHNSTONE, M.D., F.R.C.S.

HISTORY: Mrs. W. R., primigravida. Confinement expected on July 16, 1920. Urine examined at intervals of three weeks from April onwards. No abnormalities detected.

Dr. Hill Buchan was called in late on the evening of June 17 on account of a "breathless attack." He found the patient sitting up in bed in distress. Physical examination of the chest proved negative. There was some œdema of the legs, and she complained of constant pain in the abdomen. The uterus was tender on palpation and felt hard and tense. Before the doctor's arrival there had been no external hæmorrhage, but it began a few minutes afterwards. It was not at all profuse, but the patient felt considerably relieved after it had occurred, and the uterus felt distinctly less tense. No fœtal heart sounds were audible. Vaginal examination was negative.

Immediate removal to hospital was arranged. In the cab the patient's pulse, which was rather poor to begin with, became worse, and she became breathless again, and complained of great thirst.

Before the evening of June 17 the patient had been able to carry out her ordinary household duties without complaint, but for the two days immediately preceding the attack she had not felt quite so well.

State on Admission.—The patient was somewhat collapsed as the result of a fairly severe hæmorrhage, and as no placenta could be felt, the diagnosis of accidental hæmorrhage was made. There was considerable œdema of the trunk and lower limbs; and the urine was scanty and contained a large quantity of albumin. As the condition of the pulse did not indicate any immediate danger, it was decided to allow the patient to rally before undertaking any treatment. As the morning progressed, however, the pulse-rate become increasingly rapid, although there was no further vaginal hæmorrhage. The uterus also became gradually larger and harder. Toxic symptoms now began to manifest themselves in a dimness of vision, sickness and a slowly increasing tenderness to coma. By the early afternoon she had complete suppression of urine, and had shown several twitchings of the face, but had not had any actual fit. The diagnosis of concealed accidental hæmorrhage with progressive toxæmia was made, and as the cervix was quite closed and rigid, Cæsarean section was determined upon.

The Operation.—Under anæsthesia induced with chloroform and maintained with open ether, the abdomen was opened by a mesial incision. The condition of the uterus at once attracted attention. The upper part of the anterior wall appeared deeply congested and hæmorrhagic. This was most marked in the region of the right cornu. where the wall presented a deep purple or black appearance evidently due to hæmorrhage. The same appearances were present in the adjacent broad ligament and proximal half of the Fallopian tube. It was remarked at the time that the appearances suggested some interference with the right ovarian vein, associated with "backward pressure" and hæmorrhage. There was a small patch of subperitoneal hæmorrhage just below the left cornual region, but otherwise the left side of the uterus was paler and more normal in appearance. On opening the uterus by the usual mesial incision it was noted that the uterine wall was deeply infiltrated with extravasated blood of a dark colour. The placenta lay on the posterior and right lateral walls. It was separated from the right lateral wall by a large retroplacental clot, whilst its left half was still attached to the posterior uterine wall. The child was immediately extracted, and, although dead, it showed no evidence of maceration. The placenta was then detached manually. At this stage it was decided that the condition of the uterus was such as to make its removal desirable. Supravaginal hysterectomy was accordingly carried out. The abdomen was closed as rapidly as possible and the patient returned to bed. Intravenous saline transfusion was performed during the closing stages of the operation, but the patient's condition rapidly became worse and she died four hours later.

PATHOLOGICAL DESCRIPTION.

Uterus.—The external appearance of the anterior wall has already been described. The posterior showed similar changes. At no point was there any fissuring of the peritoneum (*see* Plate, fig. 1). A horizontal section made just below the orifices of the tubes showed extensive hæmorrhages in the muscular wall of the right half of the uterus. The left half was similarly involved but to a much less extent. Over the area corresponding to the deepest superficial coloration the hæmorrhage was most evident towards the peritoneal aspect. The decidua showed no evident changes.

Microscopically the muscular wall in the affected areas was ploughed up by hæmorrhage, the muscular fibres showing all stages of degeneration. In the non-hæmorrhagic regions the muscular fibres were healthy. There was thrombosis in the veins of the uterine wall.

Placenta.—In the fresh state the placenta showed attached blood clot over the separated area—roughly about a third of the total placenta. The remainder of the decidual surface was normal except for a small clot attached along the margin. Even to the naked eye there was an evident differentiation of the placenta into two areas. The area of separation had a deep purple colour whilst the remainder was paler. On section in the fresh state the line of demarcation between these two areas was clearly marked. After hardening in formalin for one night the appearance shown in the plate was present (*see* Plate, fig. 2). The differentiation was still more evident and two other areas of infarction, one recent, the other old, were noted in the attached portion, and one old and pale infarct at the margin of the separated part.

Microscopically the separated area of placenta showed the signs of early infarction—namely, coagulation in the intervillous spaces and congestion and crowding of the villi.

A full post-mortem was refused, but permission was given for the abdomen to be reopened. The liver and kidneys were accordingly removed.

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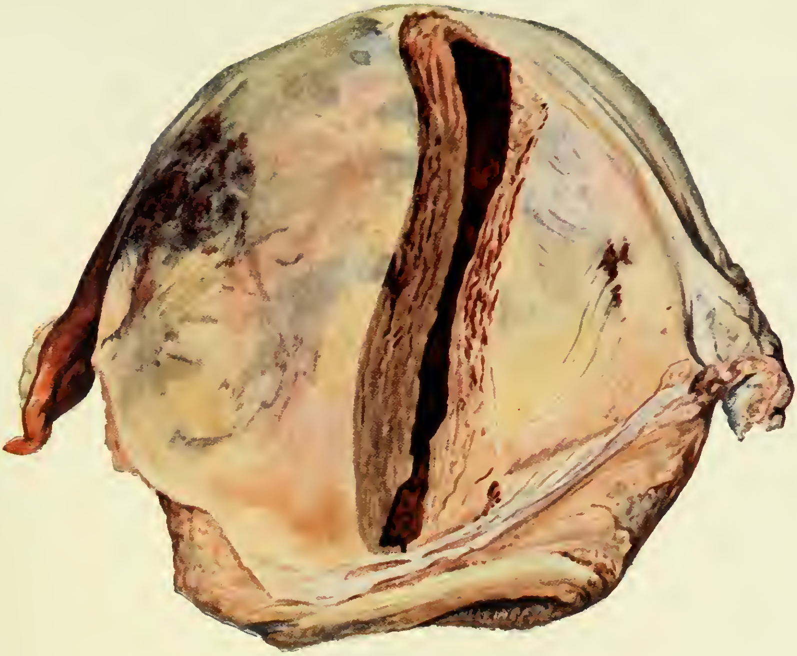

FIG. 1 (*a*).

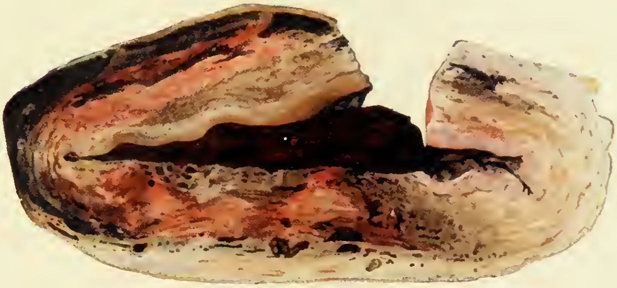

FIG. 1 (*b*).

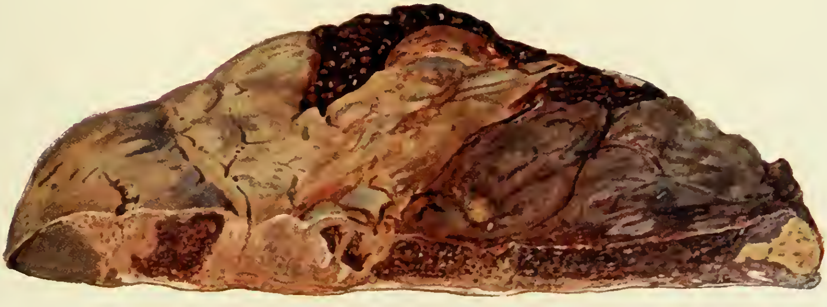

FIG. 2.

Fig. 1 (*a*).—Anterior aspect of uterus after removal.
Fig. 1 (*b*).—Horizontal section across uterus just below level of the tubes.
Fig. 2.—Portion of placenta showing appearances on section.

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Case of Concealed Accidental Hæmorrhage with Eclampsia.

Liver.—This showed multiple subcapsular hæmorrhages and its surface was pale and fatty. On section the appearances typical of eclampsia were present—namely, extensive hæmorrhages and fatty and necrotic changes.

Kidneys.—The cortex was thickened and fatty, with multiple small areas of more marked degeneration.

SUMMARY.

The reasons which have led us to record this case are: (1) Its interest as a case of so-called "uterine apoplexy" associated with eclampsia; (2) the gradual development of the toxic symptoms subsequently to the first indication of placental detachment, which appears to lend support to the view advanced by Dr. James Young that the toxic symptoms are dependent on the separation and degeneration of the placenta.

The naked-eye evidence of massive placental degeneration provides a reasonable source for a placental poison.

Further Observations on the Ætiology of Eclampsia and the Pre-eclamptic State.

By JAMES YOUNG, D.S.O., M.D., F.R.C.S., and DOUGLAS A. MILLER, M.B., Ch.B.

THE present communication consists of confirmation of an explanation of eclampsia, which one of us published in 1914. It is based on a study carried out at the Royal Maternity Hospital, Edinburgh, of forty cases of toxæmia and associated conditions.

The original investigations professed to show that the eclamptic and the pre-eclamptic toxæmias were dependent on a placental necrosis and they culminated in the experimental reproduction in animals of a disease closely simulating the classical picture of eclampsia.

The first observations were concerned with a study of the pathology and with experiment. To-night we propose to give a third link of proof, the clinical.

Eclampsia and the pre-eclamptic state of toxæmia are due to the circulation in the mother's blood of a specific substance or specific substances, the dominating effects of which are: (1) Degenerative changes in the kidney and albuminuria; (2) characteristic necrotic lesions in the liver; and (3) convulsions. The symptom-pathological complex is found only in pregnancy, and it is therefore dependent, in some way or other, on the child or on the placenta or on both, and its occurrence in cases of hydatid mole, where there is no fœtus, points to the placental elements as the source of the poison.

Placental disease of the nature of infarction is common in eclampsia and pre-eclampsia. In fact the typical case of long-standing pregnancy albuminuria shows multiple pale areas of necrosis in the placenta. On the other hand, many cases of fulminating eclampsia show no obvious change in the placenta and the natural inference for long was that, where infarction was present, it was only of secondary importance. If related to the toxæmic state at all, and related it must be, every one who has studied the subject admits, it is considered as more the result of the toxæmia than the cause.

What first directed our attention to the subject was the discovery that, although obvious placental disease might be absent in the placenta of a fulminating eclampsia, which ends in rapid labour or in death, in the other, less virulent type, in which some days or even weeks elapse between the seizure and the birth of the placenta, there is always massive necrosis visible to the naked eye. We have seen no exception to this law. Its recognition threw a flood of new light on the subject. It showed that the degenerative change is always present in the placenta, but that it requires some days before it evolves into the form of ordinary naked-eye infarction. As a matter of fact, the recognition of the real character of the change has made it possible of detection at an earlier period, if it is looked for.

If these observations are correct they have a double significance. In the first place, they provide us with a tangible focus for the origin of a placental poison. If we except Veit's discarded theory of the deportation of chorionic villi into the blood-stream, they offer such a focus for the first time. In the second place, they indicate that, if the necrotic areas are the source of the eclamptic poison, this poison is produced during the early autolysis of the disintegration process, and whilst the structure of the placenta shows no change, or only few visible signs of change. By the time the process has progressed to the stage of ordinary naked-eye infarction, the damage has been done.

Gradual piecemeal involvement of the placenta may produce in the end an extensive infarction consisting of small isolated necrotic areas of differing ages and with no symptoms except a toxæmia, which may never at any one time be of a virulent nature and may, in fact, escape notice. A sudden single, massive placental death may, on the other hand, kill before there is even a trace of visible infarction.

At the time of our original investigations in 1914, the idea that products eliminated from the disintegration of tissues at such an early stage could be toxic was a new one in pathology. There were no analogies from other branches of medicine to guide and encourage us. That the impressions formed on the basis of our anatomical studies were, however, well founded was borne out in a very complete degree by the results of our experimental work. We showed that autolysis of the human placenta increased its toxicity to the lower animals and, moreover, we demonstrated that the early autolytic materials are more toxic than those present later; it seemed as if the early toxic matter was labile, and, if left, became broken up into less noxious elements, perhaps as the result of the continued action of the cell-enzymes. We claimed at that time to have reproduced in the lower animals, by the injection of the early autolytic products of the placenta, a disease exhibiting the classical features of human eclampsia. At that time, as we have said, the conceptions underlying our belief were new in pathology. Since then, however, it has been recognized that similar factors operate in other diseased conditions, and so exactly have these new developments followed the lines laid down in our original investigations, that they provide, by analogy, strong proof of our thesis.

We would specially direct your attention to the investigations on the origin of shock (Quénu, Delbet, &c.), and more especially to the experimental reproduction of toxæmia by the injection of the products of damaged muscle. Delbet has demonstrated, by an extensive and convincing series of experiments, that the fission products of muscle are toxic even in the very earliest stages of disintegration. The results have been confirmed by others. A very interesting discovery made during these experiments was that the animal might die immediately or within a short time from an apparent intoxication of the nervous system. On the other hand, it might live for hours or a day or more and then die from damage to the liver or suprarenal capsules. As Delbet says, "Ces morts retardées sont dues à des altérations du foie et des capsules surrénales." The application of these findings to eclampsia will become apparent in the later part of this paper.

Our original investigations were arrested by the war. Since their recommencement during the past year we have confirmed our anatomical and experimental results. But to-night we desire more particularly to adduce another and different line of proof based on clinical observations, to be preceded by a brief recapitulation of our previous observations on the pathology and ætiology of placental infarction.

PATHOLOGY OF INFARCTION.

The pathological changes in an infarcted area of placenta are :—

(1) *Coagulation in the Intervillous Spaces.*—This, as we shall see, is due to a blockage of the corresponding maternal vessels.

(2) *Congestion of the Vessels in the Fœtal Villi.*—This is early and characteristic. The expansion of the vessels causes a swelling of the villi, which become closely packed together so as to form a solid block resting against the decidual surface and sharply differentiated from the surrounding spongy placental substance. This hepatization is not entirely due to the turgescence of the individual villi. It is due also, probably largely, to the tension of the environing placenta, which presses in on an area in which the circulation is arrested. The infarcted block is thus really an area of collapsed placental tissue.

(3) *Necrosis.*—During the necrosis the villi undergo disintegration of their cellular elements until, in the end, they are represented by mere ghost-like outlines. During the process the infarct passes through a series of colour changes. In the beginning it is purple or red, then it becomes chocolate-coloured, then brown, and, with the disappearance of the hæmoglobin, the colour eventually of an old infarct is yellow or white. The entire evolution of change requires a considerable number of days.

The naked-eye recognition of infarction is easy when it is fully established ; the pale infarct is so distinctive that it forms a prominent feature of the cut section of the placenta. The red or purple infarct is more likely to escape notice as its colour may not differ greatly from the surrounding placenta. Except in the early stages, however, it is solid and is, therefore, sharply cut off from the surrounding soft and spongy placenta. In the intermediate stages an infarct may be red in one part and pale in another. In many of the early cases the infarction can only be recognized when the cut section is gently washed with running water. This rinses the intervillous blood out of the healthy parts of the placenta, which become pale, and thus brings into sharp relief the purple blocks of infarcted tissue in which the blood is clotted and is therefore not removed by the washing.

ÆTIOLOGY OF INFARCTION.

As we have shown in another communication the underlying factor is an interference with the maternal blood supply. This may be due to simple mechanical factors—e.g., *separation of the placenta from the uterus* by trauma or retroplacental bleeding. These are the circumstances that commonly accompany a case of accidental hæmorrhage. Another common condition of a somewhat similar nature is placenta prævia, the bearing of which on the questions under discussion will be mentioned later.

In many instances there is no evidence of placental separation or of retroplacental bleeding, and the local impairment of the blood supply that ends in placental necrosis is due to *thrombosis*. We have noted this frequently, and we believe it to be an important cause of infarction.

ACCIDENTAL HÆMORRHAGE AND TOXÆMIA.

Retroplacental hæmorrhage is a common cause of placental degeneration, and it is of special interest to us on account of the frequency with which it is associated with toxæmia. The frequency of albuminuria in accidental hæmorrhage is given by different authors in figures varying from 30 to 80 per cent. or over. Our own ratio is nineteen times in a series of twenty-one cases—i.e., 90 per cent.

It is often urged that the toxæmia is the cause of the bleeding, and one can see how the discovery of the common association of the two conditions should have given rise to this belief. But the following considerations render the validity of the common interpretation questionable :—

(1) Accidental hæmorrhage is relatively much rarer in primiparæ than in multiparæ, though toxæmia is specially prone to affect the former.

(2) A study of the ætiology of accidental hæmorrhage shows that a severe strain or other mechanical factor may cause the condition in a woman who was apparently healthy up to that time. The importance of a purely mechanical factor is well brought out by the clinical study of our cases. In four out of a series of twenty-one cases the bleeding followed the performance of such severe exertion as the washing of clothes, or it succeeded an accident, such as falling down stairs. And in all these cases there was albuminuria. In two cases the albuminuria developed after the bleeding ; the importance of this will emerge later.

In most cases of accidental hæmorrhage, the bleeding occurs in the site of least resistance—namely, in the displaceable retroplacental area. In other cases, however, the bleeding is widespread and, coincident with the retroplacental extravasation, there may be a deep infiltration of the muscular wall of the uterus and of the broad ligaments, a condition which has been called "diffuse uteroplacental apoplexy." In our series there are two cases of this remarkable condition. In the one the extravasation involved the whole uterus and the broad ligaments on both sides. In the other the bleeding was localized chiefly at the right cornu and the adjacent part of the tube and broad ligament. The appearances are exactly those that would be produced by a sudden blockage of the right ovarian vein. The intense and sudden congestion of the uterus which is produced in these cases resembles the change induced in a pedunculated ovarian or fibromyomatous tumour by an acute torsion of its pedicle. What is the cause of the sudden blockage of the veins in the pelvis that alone can account for a backward pressure sufficient to tear open the vessels of the uterine wall? Is it a thrombosis or a kinking, or is it due to a sudden increase of the intra-abdominal pressure?

(3) A study of the placenta in cases of accidental hæmorrhage provides another series of considerations in support of the theory which we are advocating. Cases of accidental hæmorrhage may be divided into two classes: (*a*) Those in which the placenta shows little or no evidence of degeneration; and (*b*) those in which the placenta exhibits degeneration of the detached area or areas.

(*a*) Here sufficient time has not been allowed for the full development of infarction. This category includes cases in which the birth of the placenta follows quickly on the onset of the bleeding, and in it are numbered most cases of external bleeding. Toxæmia is inconspicuous, and, if present, is represented by a slight, transient albuminuria.

(*b*) Here the placenta throughout the detached area shows the signs of early infarction. The placenta has been retained in the uterus for some time and, whilst the one part of the organ has remained intact and healthy, the other part has become transformed into a mass of degeneration. The degree of hepatization present is dependent on the interval that has elapsed between the local bleeding and the birth of the placenta. This observation is one which we have made so often, that we have removed it from the category of the occasional or the accidental. It is invariable.

We have seen one case in which nearly half of the placenta was in a state of early purple infarction. In other cases the bleeding has taken place over small areas—the so-called retroplacental hæmatomata—and the infarcted regions are correspondingly small. Between these two extremes there are all grades in the extent of the retroplacental bleeding and, therefore, in the size of the subtending areas of infarction. Toxæmia is a dominating feature in this class of case. The most severe toxæmias in our series of retroplacental hæmorrhage belong to this class. It includes five cases of eclampsia.

(4) Finally, that the toxæmia is secondary is shown by the fact that one has actually demonstrated that it develops subsequent to the hæmorrhage. In two of our cases an examination of the urine within a few hours of the bleeding was negative, whereas at a later examination an albuminuria was revealed. An albuminuria develops so rapidly after the separation of the placenta that it is usually present by the time the patient is admitted to hospital. In many cases, especially of external bleeding, the albumin may never be present except as a trace. It develops early, and in the great majority of instances it passes off early.

It will have become apparent that, if our observations are correct, in order that a toxæmia may develop the placenta must necessarily maintain its attachment to one part of the uterine wall. Only otherwise can it receive and pass into the maternal blood the products of the adjacent necrosis. The placenta is like a large bag in which there is a free circulation of blood, and a necrotic area is thus like a poison-laden mass introduced directly into the maternal vessels. A recognition of this fact accounts for the well-known clinical observation that the toxæmia often ceases with the intra-uterine death of the child and the complete separation of the placenta.

A suggestive analogy to the conditions which obtain in placental degeneration is supplied by the observations of Quénu in regard to shock. He showed that the application of a tourniquet to a shattered limb prevented the occurrence of shock by blocking off the source of the disintegration products, whereas the removal of the tourniquet by re-establishing a communication with the systemic circulation was followed by toxæmic symptoms. These observations are comparable to ours; toxæmia from the placenta can only arise and be maintained if and so long as part of the placental circulation persists.

PLACENTA PRÆVIA AND TOXÆMIA.

It sometimes happens that, in placenta prævia, the detachment of the placenta commences some time before the delivery of the uterine contents. If our thesis be correct such cases should be associated with a toxæmia. We therefore decided to conduct an investigation along these lines.

Albuminuria is the earliest definite sign of a toxæmia that we possess, and in this investigation, as in the similar investigation of cases of accidental hæmorrhage, the presence of albumin in the urine was taken as a test. This sign is sufficient, but it is well known that a trace of albumin may be present without any other evidence whatever of a toxic process.

Toxæmia has, so far as we know, never been recognized as bearing any relationship to placenta prævia, though a number of cases have been recorded in which low implantation of the placenta was combined with albuminuria. The concurrence has been, however, considered as a chance phenomenon. Recently Jardine and Kennedy reported a series of eleven cases of toxæmia so severe as to lead to complete suppression of urine, and in two of these (i.e., 1 in 5½) there was placenta prævia. These conditions are each so rare that unless there is a possible mutual dependence they should occur together only once in several hundred thousand cases.

For this investigation, as for the similar investigation of the cases of accidental hæmorrhage, a catheter specimen of urine was obtained as soon as possible after the admission of patient to hospital and also at subsequent intervals thereafter. In all the cases bleeding had commenced before their admission.

Our series consists of ten cases of placenta prævia. Of these five had no albuminuria throughout. In five cases albuminuria was found. In two it increased from a trace at one examination to a heavy deposit at subsequent examinations. In one the albuminuria was absent at the first examinations and only developed later. In three of the patients the albuminuria was associated with other evidences of toxæmia, œdema of the face, headache, &c., whilst in one of these cases the toxic symptoms were so great that the patient's condition caused considerable anxiety.

This record is striking, and it is, we believe, a powerful confirmation of the argument we are attempting to prove to you. The series is, however, too small to warrant any far-reaching conclusions and we wish to resist any such temptation. We would rather say that we welcome the opportunity of presenting this evidence, especially because it is of a nature that can be put to a ready test in any obstetric clinic. We shall be glad to hear the results of any others who make similar investigations. The facts, however, arouse the suspicion that, in the past, the toxæmia which apparently is liable to occur in placenta prævia has been overlooked, and has been attributed to the collapse and the anæmia of hæmorrhage. As a control, we examined two cases of severe hæmorrhage at intervals and, in each case, the urine gave negative findings. The changes in the detached prævia portion of the placenta are exactly those which we have described in the detached placenta of accidental hæmorrhage. Where time has been allowed for their development one finds the macroscopic and microscopic features of early infarction.

OTHER CAUSES OF PLACENTAL DEGENERATION AND TOXÆMIA.

In the preceding pages it has been shown that mechanical factors may cause a detachment of the placenta from the uterine wall, and, as in placenta prævia and in some cases of accidental hæmorrhage, such a mechanical detachment is the cause of the degeneration that ends in toxæmia. It often happens, however, that in cases of ordinary infarction of the placenta the exact cause of the impairment of the maternal blood supply is difficult or impossible to discover by an anatomical examination. In some such instances there is a thrombosis in the decidual vessels, and we believe that this factor probably operates in a number of cases. But it is impossible of proof, for one cannot tell from the microscopic appearances whether the thrombosis has preceded or followed the necrosis.

So, in many cases of eclampsia and albuminuria, in which definite placental disease is present, the exact origin of the blockage of the maternal vessels may not be evident. We have shown, we believe conclusively, that such a blockage can alone account for the placental changes. How, then, are we to explain it in the absence of such simple factors as are present always in placenta prævia, and often in accidental hæmorrhage? Do mechanical influences operate in these cases as well? In this connexion we would again direct your attention to one of our cases in which the retroplacental bleeding was associated with a hæmorrhage into the uterine wall, the tube, and the broad ligament in a way which we could only explain by supposing the occurrence of a sudden strangulation of the right ovarian vein. In the other case of "diffuse uteroplacental apoplexy" the appearances again suggested a mechanical strangulation of the veins, but here of both ovarian and perhaps of the uterine veins as well. The conditions were similar but more extensive.

We have referred to the remarkable and suggestive similarity between uteri showing these evidences of strangulation and an ovarian tumour or a pedunculated fibromyomatous tumour with a twisted pedicle. The conditions are so alike that it is almost impossible to escape the conviction that similar causes are operating.

If there are intra-abdominal influences, perhaps of the form of heightened tension which can in their extreme form culminate in such a dramatic vascular change, it is almost certain that these same pressure factors act at other times in a less marked degree. It is known that in primiparæ, especially, there are evidences of increased intra-abdominal tension—e.g., swelling of the feet and legs, and distension of the right ureter. Is it possible that similar agencies tend to cause venous stasis? In their extreme form this would result in complete strangulation, whilst in their more mild degree it would result in thrombosis of the veins of the retroplacental area or of the uterine wall.

Localized degeneration in the placenta must be due to blockage of the corresponding vessels. Of this we can be certain, but the ultimate explanation must remain of a theoretical nature until we have a more intimate knowledge of the vascular conditions that obtain in the abdomen and pelvis during pregnancy. Paramore maintains that he has actually demonstrated the existence of a heightened intra-abdominal pressure during pregnancy. We have not had an opportunity of carrying out investigations along these lines, but we have a strong belief that it is by such a research that we shall eventually explain the local necrosis of the placenta, which underlies some, if not all, of the toxæmias of the end period of pregnancy.

THE ORDER OF SEQUENCE OF THE PATHOLOGICAL CHANGES IN ECLAMPSIA—POST-PARTUM ECLAMPSIA.

In eclampsia there are widespread evidences of a toxic process throughout the body of the mother, the most prominent of which are the damage to the kidney and liver and nervous system, and the œdema of the subcutaneous tissues. Whether these diffuse changes occur simultaneously in gradually increasing intensity or whether they follow a definite sequence in their development we have so far no means of ascertaining. In the majority of cases, in which the complex of changes culminates in an eclamptic seizure, the clinical picture is completed before or during labour. In other instances, however, the end stages are only enacted after birth, and the convulsions, coma, &c., develop some hours after the escape of the uterine contents. Post-partum eclampsia constitutes a difficulty that must be candidly faced by the research worker, and it has long been apparent to us that an understanding of this variant of the disease would probably throw new light on the ultimate nature and origins of the toxæmia. Anomalies are often of greater value than the commonplace features in directing attention to the underlying facts of a disease.

In a preceding communication we tentatively suggested that a piece of dying placenta retained in the uterus might account for the puerperal seizures. This idea we no longer hold, and we are not in a position to offer any other explanation that we can support with proof. We would direct your attention, however, to some interesting analogies, which may throw some light on the cause of the delay in the manifestation of the symptoms in a post-partum seizure. There are not a few toxæmias in which a definite interval is known to exist between the introduction of the poison and the development of the symptoms. In chloroform poisoning the phenomena of toxæmia may not develop for a day or two. But a more interesting analogy is seen in phosphorus poisoning. Here the introduction of a toxic dose may lead to immediate signs of irritation. These pass off and not till forty-eight hours later do the major evidences of toxæmia develop, amongst which convulsions may be present. The analogy between the effects of these chemical poisons and eclampsia is brought home in a striking manner by a study of the tissue changes. In both of the chemical poisons massive damage to the liver occurs, and in delayed chloroform poisoning the liver changes may closely simulate those present in eclampsia. It is impossible to avoid the inference that the immediate cause of the symptoms in such cases is the flooding of the system with the breaking-down products of the liver cells (and perhaps of other organs as well), which were killed at the time of the introduction of the poison and which in their turn, after a varying but considerable period, generate a new and different poison.

We hold that a conception of this sort is reasonable and it suggests that eclampsia, as we know it, is possibly not the manifestation of the immediate results of the placental poison, but it is dependent on the flooding of the mother's system with the fission products of the cells of the liver (and perhaps of other organs). It is, as it were, a secondary toxæmia that requires some hours or even days for its culmination. If this explanation be correct, it accounts for the occasional delay of the end stages of the toxæmia till the post-partum period.

The analogy of the toxic effects of damaged muscle, to which we have referred on a preceding page, is even more suggestive than that drawn from a study of the chemical poisons. The actual products eliminated from the dying tissues of the leg probably resemble those produced in the placenta. As the researches of Delbet and others show, the lethal result in the former case may be delayed for some time, and the animal eventually succumbs to the effects of the disintegration of the liver and suprarenal glands.

SUGGESTIONS REGARDING THE TREATMENT OF ECLAMPSIA AND ALBUMINURIA.

There are some suggestions with regard to the treatment of the toxæmias of pregnancy which emerge from this research :—

(1) Separation of the placenta and retroplacental thrombosis are in some cases, and perhaps in the majority of cases, the factors underlying placental degeneration. Mechanical influences, strain, undue exertion, &c., undoubtedly predispose to these occurrences. Rest should, therefore, form a cardinal part of the treatment of all such cases. In this way an albuminuria may subside because increasing degeneration of the placenta is avoided.

(2) Immediate emptying of the uterus is, theoretically, the ideal line of treatment in severe albuminuria and in eclampsia. It is the ideal method, no matter what theory we adopt regarding their origin, for all are agreed that pregnancy is the ultimate cause. In view of the above theoretical considerations, however, it is possible that when major symptoms develop they are due to a poison introduced into the system some considerable time before and, in the interval, the placental danger has subsided or disappeared.

Considerations of this kind would account for the very varied results that follow evacuation of the uterus, and they make logical the attitude adopted by most obstetricians, that severe manipulative measures are apt to stir up the toxæmia to a dangerous degree, especially by provoking convulsions, which are readily inaugurated by stimulation of the nervous system.

SUMMARY.

(1) Eclampsia and pre-eclamptic toxæmias are due to the products of the early degeneration of a piece of placenta, the blood supply of which has been interfered with.

(2) Infarction of the placenta may be due to mechanical detachment of the organ from the uterine wall—e.g., in placenta prævia and in some cases of accidental hæmorrhage. In other cases it is due to thrombosis; this is the factor operating in most cases of eclampsia.

(3) Where time is allowed for the elaboration of toxic elements from the detached placenta toxæmia develops. In concealed accidental hæmorrhage, therefore, toxæmia is conspicuous. Absorption of placental poisons only occurs if and whilst part of the placenta remains attached to the uterine wall.

(4) Toxæmia occasionally accompanies placenta prævia for the same reasons.

(5) The toxæmia develops after the hæmorrhage; it is therefore not the cause of the bleeding in accidental hæmorrhage.

(6) The major symptoms of eclampsia are probably due to the flooding of the mother's system with the breaking-down products of liver cells (and perhaps of other tissues), which were killed some hours or days previously by the placental poison. Compare the interval that elapses before the development of symptoms in phosphorus poisoning, &c. A consideration of this sort accounts for the occasional occurrence of post-partum seizures.

(7) Recent investigations on shock (Quénu, Delbet, &c.) support by analogy this conception of eclampsia. These observers have shown that the early disintegration products of muscle are toxic. The injection of these substances into an animal may kill at once. On the other hand the lethal effect may be delayed for some time, in which case it is due to degeneration of the liver and suprarenal glands. The changes induced in the liver in such a toxæmia resemble those found in the liver in eclampsia.

These investigations were carried out at the instance of the National Research Council, from whom a grant was received. The pathological and experimental studies were conducted at the Royal College of Physicians Laboratory, Edinburgh.

LITERATURE.

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DISCUSSION.

Dr. R. H. PARAMORE (Rugby) said that Dr. Young had described placental changes in the toxæmia of pregnancy—areas of necrosis—and had assumed that these were the origin of the toxæmia in question. Dr. Paramore thought the time had come when the Section might with advantage consider the conception that the lesions pathognomonic in eclampsia—the necrosis of the liver and kidney cells—were *primary* to the toxæmia. He discredited entirely the prevailing view that the toxæmia of pregnancy existed before the maternal visceral lesions. He believed that the changes found in the developing ovum and in the maternal viscera were due to a common cause; that this cause was not a toxæmia; and that only when the lesions had formed did a toxæmia arise as their result. In 1909 he had stated his belief that the disease was caused mechanically; and in 1913 he had given the Section an explanation as to how the pressure in the abdomen in pregnancy was increased. In the series of women examined, two were suffering from the toxæmia of pregnancy; and in these two the highest pressures of all were found. He would emphasize the effect of the increased intra-abdominal pressure in pregnancy on the visceral *capillaries;* if the pressure rose to a certain amount, the capillaries in certain organs could be easily obliterated. If the blood were prevented from passing through parts of the organs, then the cells in these parts would necrose, and a subsequent toxæmia ensue.

Mr. GORDON LEY had, previously, been much impressed with Dr. Young's excellent description of the changes in the placenta occurring during so-called infarction. With regard to the suggestion that the many manifestations of toxæmia of pregnancy were produced by placental autolysis, he could not agree. He considered that Dr. Young was confusing the cause with the effect and considered, as he had already shown, that the changes in the placenta were secondary to hæmorrhage, produced by focal necrosis in the wall of the uterus and in the decidua. He had met with about 125 cases of placenta prævia; in only one was there toxæmia of pregnancy and this was a primigravida. If Dr. James Young's theory were the correct one, one would expect toxæmia of pregnancy in association with threatened miscarriage, carneous and vesicular moles, as here there was just as much placental separation as was often present with retroplacental hæmatomata associated with toxæmia. Further, if Dr. James Young were correct, placental changes would always be found in all long-standing albuminurias; this was not true. How could Dr. Young explain the frequent incidence of retroplacental hæmorrhages in association with chronic kidney disease?

Dr. MACKENZIE WALLIS remarked that he had been engaged on research work on the same subject. He had commenced his work on the assumption that the toxæmias of pregnancy were in some way related to changes in the placenta. All his work had tended to show that the placenta played little if any part in the causation of the condition. The hæmorrhages and subsequent necrosis in the placenta were in his opinion due to the same cause as those observed in the kidneys, liver and other organs. The toxins elaborated in the body of the pregnant woman exerted their action primarily on the maternal blood-vessels. The first change observed in the kidneys in eclampsia was a thickening and inflammatory fibrosis of the capillary tufts of the glomeruli. Exactly similar changes were observed as the result of poisoning by metallic salts, &c., and the urinary changes were similar. This thickening of the vessels could be produced in a very short time, as was seen in the profound changes in the kidneys after acute arsenical poisoning. The same changes probably occurred in the cerebral vessels, producing cerebral œdema, and the characteristic eclamptic fits. Following upon these changes in the circulation they found necrotic changes. The changes so induced might also be responsible for the hæmorrhages and necrotic areas observed by Dr. Young in his cases of eclampsia. This view of the action of the toxin or toxins on the circulatory system explained many of the signs and symptoms of eclampsia—viz., the fits, albuminuria, high blood-pressure, also the late onset of eclampsia in some cases after the placenta had been removed. In the discussion it had been apparent that many facts tended to render the placental theory of the origin of eclampsia untenable, but it was still adhered to as the most obvious explanation. It was interesting to note that one organ universally present in the pregnant woman had been quite forgotten in the search for the origin of the toxæmias of pregnancy—namely, the ovary—the possible connexion between this organ and toxæmia had been suggested to him by his colleague, Dr. Everard Williams. They hoped at an early date to report their results to the Section.

Dr. EDEN thought that Dr. Young's work was very valuable, but he felt that there were certain difficulties in the way of its acceptance as a complete explanation of the causation of eclampsia. As he understood it, Dr. Young's theory was that as a result of retroplacental hæmorrhage massive necrosis occurred in the detached area of placental tissue; from this area toxins passed in large quantity into the maternal circulation via the undetached placental tissues, and these toxins produced eclampsia. If this view were correct eclampsia should be much commoner than it was, for the condition necessary for its production would be met with in the majority of cases of recurrent antepartum hæmorrhage—i.e., cases in which the first hæmorrhage was not followed by labour. Dr. Eden felt the same difficulty in accepting the view that mild forms of toxæmia were due to placental infarction, for infarction was almost universally found in the mature placenta.

Dr. JAMES YOUNG (in reply) stated that he believed that for an eclamptic seizure it was necessary that one-third or one-half of the placenta be infarcted. As the poisons were elaborated within a few minutes or hours of the process, visible changes in the placenta were usually absent in a fulminating case. In one of his cases, however, as he had shown, there was early purple infarction of nearly one-half of the organ; this was a case of eclampsia. The small infarctions which Dr. Eden and others had referred to were only important in so far as they explained cases of albuminuria, in which the toxæmia was never sufficiently great to cause a cessation of the pregnancy. It was, in fact, the small size of the infarction that allowed the pregnancy to continue. Dr. Young had found necrotic changes in the muscular wall of the uterus in cases of uterine "apoplexy," but he was convinced that this necrosis was secondary to the damage caused by the extravasation. Local necrosis in the uterine wall did not account for the widespread bleeding in the broad ligaments, tubes and ovaries. The objection which Mr. Gordon Ley had raised, namely, that toxæmia was not present in ordinary abortion, was explained by the fact that separation of the ovum was usually complete at an early stage. Dr. Young and Dr. Miller had found albuminuria with partial separation. Dr. Mackenzie Wallis had not obtained toxic effects from the autolysis of placenta. This was probably due to the fact that he had continued the autolysis too long, for the most toxic ingredients were produced within a few hours, and later became split up into less poisonous elements. Dr. Young was interested at having heard Dr. Paramore say that he had found increased intra-abdominal pressure in cases of toxæmia. He (Dr. Young) believed that this factor might predispose to venous stasis and consequently to placental degeneration.

Section of Obstetrics and Gynæcology.

President—Mr. HENRY BRIGGS, F.R.C.S.

The Use of Morphia in Labour.[1]

By A. LOUISE MCILROY, M.D.

(ABSTRACT.)

THIS preliminary communication on the use of morphia in labour is based upon a year's experience of the administration of this drug in the officers' wives' department of the 82nd General Hospital, B Section, Constantinople, where I was acting as gynæcological specialist. A large number of American women, and better class Turkish, Greek, Armenian, and Russian patients were admitted, the Russian patients being especially neurotic owing to their trying experiences. The majority were primiparæ; the labours were long but without serious complications. Statistics as to numbers are not at present available. The patients were not selected in any way. Morphia was given in complicated labours, and to patients with albuminuria, &c. Morphia, being obtainable, was employed instead of omnopon. My experience of omnopon in pre-war practice had led me to value its aid in prolonged labours. I had so little experience of scopolamine-morphia that I was unwilling to risk its trial under the conditions. The usual routine of hot baths, enemata, &c., was carried out with each patient. No shaving nor douching was employed, and no vaginal examinations were made except in cases where complications were suspected. To such precautions I ascribe the absence of septic cases among those treated during the year. The lines of normal labour were induced as far as possible in every case, and morphia was given as a means of rendering the labour as physiologically easy as possible. Isolation from relatives was not always procurable in this part of the world. The lights in the room were shaded and quietness was enjoined. As soon as labour was definitely established morphia was given with the object of calming the restlessness, and also for the relief of pain. It was found, however, after experience of a number of cases, that the drug tended to hurry the first stage, and it was subsequently given with the primary object of hastening the progress of labour. It caused, in some cases, an apparent diminution of the uterine contractions as felt by palpation of the abdomen. Dilatation of the cervix proceeded notwithstanding, as evidenced by the change in the character of the pains from first to second stage type, when the patient awoke from a sleep. In some cases the patient appeared to be making little progress, and yet the head seemed to cause pressure on the perineum. After a dose of morphia had been given the patient would sleep, waking refreshed, and with strong uterine contractions. It is difficult to estimate the effect of the drug upon the uterus, since we are without any scientific method of registering the frequency and intensity of uterine contractions.

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[1] At a meeting of the Section, held January 6, 1921.

After the use of morphia in labour it was found that restlessness was controlled; sleep was intermittent and refreshing, and less fatigue was observed at the end of labour. Thirst was increased. Rupture of the membranes was delayed in a number of cases. There was no marked effect upon the child, nor was there any evidence to show that the respiratory and cardiac functions were inhibited. In no case was the patient observed to be in a state of mental excitement or confusion. The pulse-rate was unaffected. The fœtal heart sounds were kept under observation throughout labour.

Dosage.—One-sixth gr. morph. sulph. hypodermically into the arm was given as soon as labour commenced. This was repeated according to the patient's capacity for bearing pain, or if she were restless from irregular uterine contractions. The succeeding doses varied from $\frac{1}{6}$ to $\frac{1}{4}$ gr., and were given throughout labour if required; in some cases at intervals of from two to four, or from four to six hours. No definite rules were laid down for dosage; each patient was treated according to her particular condition. The second stage was aided rather than retarded by the administration of morphia. There was no undue delay in the third stage of labour, and no increased tendency to post-partum hæmorrhage. Convalescence seemed more rapid owing to the diminution of fatigue, and there was no interference with the secretion of milk. Forceps deliveries were fewer, and complications due to uterine exhaustion were lessened.

Morphia appears to dilate and soften the cervix; it calms the patient, lessening fatigue and shock, and it does not require the constant attendance of the medical practitioner for its administration. There were no maternal nor infant deaths during the year.

DISCUSSION.

Dr. AMAND ROUTH hoped Dr. McIlroy would continue her work so as to estimate the advantages of these small doses of morphia during the first and second stages of labour. How was the shortening of the first stage caused? Was it by the lessening of the rigidity of the cervical muscle as after chloral? Apparently in the second stage there was some relaxation of the pelvic voluntary muscles, and some lessening of the abdominal reflex contractions, but further observations were essential.

The PRESIDENT considered that Dr. Louise McIlroy's observations on a neat series of labours lessened hesitation and increased confidence in the administration of morphia; in its favour he added his own experience.

Dr. WILLIAMSON had no experience of the use of morphia in labour, but for some years had been accustomed to use omnopon when the first stage was protracted and unusually painful, and when dilatation of the cervix was slow. Omnopon contained the total alkaloids of opium, and for this reason he regarded it as superior to morphia. His experience with regard to the children had differed from that of Dr. McIlroy, for he had found that if omnopon was administered in the second stage the child was often born in the condition described by Gauss under the name "oligopnœa." No harm had resulted, and in the course of from ten to fifteen minutes normal breathing had been established. He was not satisfied, however, that the condition was entirely devoid of danger, and for this reason, amongst others, he preferred not to administer these drugs during the second stage. He did not think that they should be given as a routine, but should be reserved for cases such as he had specified. Dr. McIlroy's paper had interested him very much, but because of the absence of statistics and because no carefully observed cases were recorded, he was compelled to regard it as a mere expression of opinion and not as a scientific contribution. It was stated that morphia "prevented certain complications," but they were not told what complications they referred to. Again they were told that without doubt morphia hastened the softening and dilatation of the cervix, and that under its use the perineum was better stretched. Where was the proof of these statements? He believed that the action of morphia was to diminish sensory impulses, to reduce suffering, and enable the patient to rest more tranquilly between the pains, but he did not think Dr. McIlroy had proved that it had any specific action in increasing uterine contractions or in softening or dilating the cervix.

Dr. HERBERT SPENCER said that he hoped Miss McIlroy would make a further communication giving numbers and particulars which were wanting in that paper, owing, no doubt, to the abnormal conditions under which the work had been done. In his opinion—that of many earlier obstetricians—opium, in solid or liquid form, was a much better sedative in labour than morphia. It required no experiment to prove that morphia endangered the child's life when given repeatedly up to shortly before its birth. Miss McIlroy's patients were mostly neurotic foreigners; but it could not be too strongly emphasized that the repeated administration of powerful drugs as a routine measure was neither necessary nor advisable for ordinary healthy women.

Dr. McIlroy (in reply) said that the case records and charts were not at present available. Her notes were merely a preliminary communication on the uses of a drug which deserved consideration. The administration of morphia caused diminution of the abdominal muscular contractions while the patient slept, but after she had rested these contractions returned with greater vigour. Apart from the progress of the labour, Dr. McIlroy could give little definite evidence as to the presence of uterine contractions and their amount. A clinical recording apparatus on the lines of those used by the physiologists was greatly needed for measuring uterine contractions.

Inoperable Uterine Carcinoma treated by the Cold Cautery Method of Percy: A Series of Forty-three Cases.

By Percival P. Cole, F.R.C.S.

In 1914, at the meeting in London of the Congress of American Surgeons, Dr. J. F. Percy demonstrated his cold cautery method at the Cancer Hospital. It fell to my lot to open the abdomen and assist him by palpation while he manipulated the cautery and explained the various points in technique. Percy's efforts and writings have stimulated discussion, particularly in America, as to the utility of heat as a palliative measure in the treatment of inoperable uterine cancer. Adverse criticism has not been wanting, and controversialists have demanded the production of detailed results. I have operated on forty-three cases, and propose to give an unprejudiced account of the difficulties encountered, the dangers, real and fictitious, and the results obtained. I have been assisted throughout by Mr. O. T. Dinnick, whose collaboration has been most valuable. Unvarying assistance in an operation of this kind is an important factor, for experience gained in a succession of cases is the guerdon of operator and assistant alike and can be utilized and applied in a combined and co-ordinated progress.

Technique of the Operation.

The cautery is heated by electricity, led to it from the main current by way of a converter. The operation itself may be divided, for purpose of description, into (1) abdominal and (2) vaginal.

(1) *Abdominal Part of the Operation.*—A mid-line incision is made reaching from the umbilicus to pubes. The skin edges are protected

and a pelvic retractor of the Doyen type having been inserted into the peritoneal cavity, the intestines are thoroughly packed off with hot moist pads so that the upper abdomen is completely shut off from the pelvis because manipulations in the pelvis have to be continued over a period ranging from one to two hours. In some cases adhesions of omentum or intestine to the anterior abdominal wall or to the tubes will have to be freed before this procedure can be carried out. Thorough packing also ensures a clear and unobscured view of the pelvic contents. The internal iliac and the ovarian vessels, and the round ligaments are tied off in turn; this part of the operation takes from ten to thirty minutes. The posture of the patient is then changed from the Trendelenburg to the horizontal position. The abdominal wound is isolated from the perineum by means of a towel clipped securely across the abdomen below the lower extremity of the incision, and thrown upward to cover the wound and the hand and arm of the assistant engaged in guiding during the next stage of the operation. The patient is then adjusted in the lithotomy position, and the second or vaginal portion of the operation is commenced.

(2) *Vaginal Part of the Operation.*—In most cases it will be found necessary to dilate the vagina, and this is effected by means of a flange and screw dilator, which is part of the operating outfit. The dilatation is carried to a sufficient degree to admit of the insertion of the water-cooled speculum, also provided with the outfit. This speculum has a surrounding water-jacket space through which water is conducted by means of rubber tubing connected with a raised reservoir and drained away into a bucket placed on the floor at the operator's feet. In this way a constant circulation of cooled water through the water-jacket of the speculum is ensured, and the vaginal walls are thus adequately protected. Several types and sizes of speculum are provided with the outfit and selection is made according to the size of the vagina, the situation and extent of the growth, and the particular area of the growth to be dealt with. Through this speculum a clear view can be obtained of the cervix and the vaginal vault, this enabling a decision to be made as to whether or not a curette may usefully be employed to remove the redundant growth. The position and direction of the uterine cavity is then determined by the passage of the uterine sound, and the position and relation of the bladder to the involved cervix is similarly ascertained. The manipulation of the cautery is then commenced. The assistant, with his hand in the abdomen, from this time onwards grasps the fundus of the uterus and controls the position

and direction of the cautery point, either by verbal directions to the manipulating operator or by movements destined to bring palpable growth in contact with the heating agent. As a rule, the cautery is passed through the cervical canal until its tip can be felt at the top of the fundus by the hand of the abdominal assistant. In this situation a thorough heating of the cervix and fundus is carried out. The ordinary cooking degree of heat may be roughly estimated by trying the cautery upon a piece of wood. The heat adjusted by means of a rheostat should be just insufficient to char the wood. When the cautery is in position and in contact with the tissues, a gentle sizzling sound can just be heard by the cautery operator. The estimation of adequate heating rests with the abdominal assistant. The part in process of treatment may be pronounced by him as adequately heated when the heat transmitted from the cautery through the intervening tissues to his gloved hand is such as to be just bearable. When fundus and cervix have thus been dealt with, the abdominal assistant directs the cautery towards outlying areas in the bases of the broad ligaments. The lower portion of the cervix and involved areas in the vaginal vault must be dealt with by the cautery operator, who has these parts under his direct survey, and it is particularly in these manipulations that care and discrimination must be exercised. Although a much greater degree of heat may well be utilized in forcing the passage of the cervix and destroying growth on a thickened posterior lip, no such heating can be tolerated in dealing with the anterior aspect of the cervix and the anterior vaginal fornix. For dealing with this particular area Percy has devised a speculum interrupted for about one-sixth of its circumference. He suggests that the interruption be made to coincide with the danger area lying anteriorly, and the necessary degree of heat may be obtained therein without direct contact with the cautery, the degree of heat being estimated by means of a thermometer passed through the urethra and resting in the bladder. The changes which occur in the heated parts are characteristic. The fundus becomes soft, tumid, and juicy, so that at the end of the cauterization a varying quantity of slightly blood-stained fluid has accumulated at the bottom of the pelvis. In addition, the pelvic organs, which at the commencement of the operation had exhibited a more or less intensive degree of rigidity, exhibit a softness and mobility which is both unexpected and characteristic. The appearance of the treated area looked at from below is also characteristic. The cervix presents a large funnel-shaped crater, the sides of which are quite firm and perfectly dry and of a peculiar greyish-yellow colour.

This part of the operation being completed, the patient is released from the lithotomy position, all towels, except those clipped to the skin edges are changed, and the abdominal wall sewn up in three layers by the assistant.

In 1914 the intra-abdominal portion of the procedure was confined to directing the position of the cautery by palpation. The first few cases showed clearly enough that severe secondary hæmorrhage was a danger to be anticipated. As a preventive measure it was decided to tie both internal iliac arteries, the ovarian vessels, and the round ligaments. In every subsequent case this has been done, and no further instance of secondary hæmorrhage has occurred. Percy himself was compelled to adopt a similar procedure for the same reason.

CERTAIN DIFFICULTIES.

The ligature of the internal iliac arteries may be very easy or very difficult. In many cases the tubes are bound down at the back of the uterus to the peritoneum covering the pelvic floor, to the pelvic colon, or to the mesocolon itself. Apart from any adhesions affecting the adnexæ, the pelvic colon with its mesocolon has often contracted adhesions or adventitious peritoneal attachments to the posterior and lateral pelvic walls. When tubes and ovaries are bound down in the manner thus indicated it is essential that they be thoroughly freed, and in this case their removal is indicated. Adventitious attachments of the colon must also be freely severed to allow free access to the outer aspect of the pelvic mesocolon in order to permit exposure and ligature of the left internal iliac artery. The pelvic viscera being thus freed the ligature of the iliac arteries is proceeded with. In a case presenting any or all of the inflammatory adhesions above described ligation of these vessels is almost certain to be difficult. These difficulties, however, are dependent on such anatomical factors as the depth and conformation of the pelvis and the thickness of the abdominal wall, for it must be remembered that a considerable amount of superficial fat is often enough encountered in operating upon patients in whom cancer of the cervix has developed to such an extent as to render the condition radically inoperable.

Danger to the ureters is practically negligible, for these structures, lying as they do immediately in front of the iliac vessels, must inevitably be exposed before the vessels can be reached. Occasionally, however, it happens that the vessels lie embedded in dense tissues, the nature of which, inflammatory or malignant, is impossible to determine. Even in such a case the danger of wounding the internal iliac vein is much greater than that of causing damage to the ureter. In an ordinary case, the iliac vein separates readily from the posterior aspect of the accompanying artery, and reasonable care only is necessary to avoid damaging it. In a case such as that predicated separation is difficult and the walls of the vein, stiffened by the surrounding tissue, may well be perforated unless the greatest care is exercised. Such an accident occurred on one occasion in this series and a fatal result ensued.

On one or two occasions adhesions of omentum to abdominal wall and pelvic viscera, and dense matting of the viscera themselves, have been so extensive as to preclude a definition of the pelvic cavity, and in such a case operation must necessarily be abandoned, for it is not, I think, justifiable to proceed with the cauterization *per vaginam* without control exercised from within the abdomen. The vaginal portion of the operation may be immediately complicated by inability to define the position of the cervical canal. In such a case a passage must be forced by the cautery heated to a relatively high temperature, and guided in its course by the orientating hand of the abdominal assistant. Often the posterior vaginal wall in the region of the fornix and the posterior wall of the cervix are so destroyed by growth that they consist of little more than peritoneum. Perforations in these situations by curette or cautery are not uncommon, but owing to the relation of the recto-vaginal pouch of peritoneum the rectum itself is in little danger, and, in fact, has never been injured. The anterior aspect of the cervix and the anterior vaginal vault are not so happily situated. The close relationship of the bladder must be constantly borne in mind, for the one great immediate drawback to the operation is the development of a vesico-vaginal fistula. The area of bladder thus liable to be involved is that extending from the level of the internal os above to within three-quarters of a inch of the urethral orifice below.

Mention has been made of the interrupted speculum devised to deal with growth in this region. I have, however, found this of little practical utility. A factor of greater importance is the size and shape of the active end of the cautery. The end usually employed has far too pronounced a shoulder at its junction with the handle-shaft, and a modification of the instrument along the lines indicated would prove more efficacious in preventing the formation of these distressing fistulæ than the use of the interrupted speculum. No instance of a uretero-vaginal fistula has occurred in this series; this is somewhat extraordinary in view of the thorough heating to which the bases of the broad ligaments have been subjected and the method compares favourably in this respect with the Wertheim operation. No recto-vaginal fistula has been caused by the use of the cautery, but in a case operated on in January, 1920, a small recto-vaginal fistula followed the embedding of radium needles into the remnants of the posterior cervical wall. Secondary hæmorrhage, as already mentioned, is a formidable complication unless the internal iliacs are ligatured. This being done, bleeding at the time of operation is very slight, and the hæmorrhage as an immediate consequence of the operation is almost unknown. In one case the separation of a large slough was accompanied by a smart outburst of bleeding, but this was not repeated, and the patient made an uninterrupted recovery.

As a preliminary to the application of heat, the use of the curette as a means of removing redundant growth has been mentioned. This procedure was found to be considerably facilitated by the pelvic ligation of vessels, for oozing was reduced to a minimum, and a clear view obtained without the necessity for constant swabbing. This use of the curette is denounced by Percy [1(2)], but it certainly saves time, and cannot conceivably do any harm. Two grades of heat have been utilized—a high grade that destroys, and a lower grade that cooks. Originally Percy was opposed to destructive heat, but he admitted that this may be of value in certain positions and under careful control. In forcing the passage of the cervix, and destroying superficial growth, the use of destructive heat is undoubtedly indicated, the heat-blocking effect of the eschar being obviated by the removal of as much burnt tissue as possible. This can readily be effected with a pair of stout sponge-holding forceps. In the great majority of cases the forcing of the cervical canal has demonstrated the existence of a condition of pyometra. The appearance of many of these patients was impressively indicative of toxic absorption, and the extraordinary improvement in their complexion and facial aspect within two or three days after operation can best be accounted for on the assumption that pyometra was the causative factor. The duration of the operation has varied from one to two hours.

THE TYPE OF CASE.

Gauged by whatever standard the type of case subjected to operation was inoperable from the radical point of view. The cases were drawn from the chronic wards at the Cancer Hospital. The patients in these wards are recruited from inoperable cases so certified by practitioners or admitted as such from the out-patient department, and in every case their condition is verified by the visiting staff. By far the greater number in this series had been seen and rejected as inoperable by gynæcologists of repute at large London and provincial hospitals. The intra-abdominal condition obtaining in these late cases presented many points of interest. Matting and adhesions have already been mentioned. The rarity of demonstrable glandular invasion was remarkable. Comparative figures support the view that this freedom from glandular metastases was not only apparent, but real. Leitch [6(15)] in a series of 915 post-mortem examinations, found glandular invasion in 351, or 38·36 per cent. The number in which metastases of any kind occurred was 405, or 45 per cent.; in other words, 55 per cent. of cases which run their course without surgical intervention die as a result of effects determined by what remains to the last a local lesion.

These figures are confirmed by the notes of a series of 100 post-mortem examinations undertaken at the Cancer Hospital. Twenty-four cases had glandular deposits and nine had visceral deposits, giving a total of cases with metastases of 39 per cent.; this percentage is lower than that recorded by Leitch, but the number concerned is smaller, and includes five cases which had been subjected to radical operation. Dilated ureters on one or both sides were commonly met with. Occasionally this dilatation would be extreme, the ureter approximating in diameter to that of the little finger. It is interesting to note that Leitch in his series of 915 found the kidneys hydronephrotic and the ureters dilated in 75 per cent. of the cases.

No selection was exercised in the choice of cases in so far as concerned the local condition. Attention was directed to the general condition only, no case being dealt with unless this was sufficiently good to render reasonable the immediate risk incurred. Experience has shown that local conditions should be considered, and this aspect of the question will be referred to in discussing post-operative sequelæ. One case—not included in the series—was treated for recurrence in the vaginal vault, following a radical panhysterectomy. She suffered from oft-repeated hæmorrhage and died in a few weeks. The unsuitability of cases recurrent after radical operation had been confirmed by Percy [1(6)].

POST-OPERATIVE PROGRESS AND SEQUELÆ.

The abdominal wall in every case has healed without a trace of suppuration. Allusion has already been made to the striking improvement in general aspect that occurs within two or three days of operation. Slight reactionary temperature may persist for the first few days. It has caused no more anxiety than that which frequently obtains after a supravaginal hysterectomy. Shock has never been encountered. This is the more noteworthy in view of the age of some of the patients. Several were over 50, and one was 68. These findings are at variance with those of Bancroft, who lays stress on shock and temperature as inimical factors [2(7) (8)]. In three cases sloughs of considerable size have been passed per vaginam, and in one case the coincident loss of blood was considerable, but was not repeated. A foul discharge may commence on the third or fourth day, and persist about a fortnight. It is advisable to administer a weak iodine douche beginning on the fourth day, and continued till discharge ceases. Patients are kept in bed for three weeks and leave hospital at the end of a month.

Vesico-vaginal fistula has resulted in seven cases. This is an uncomfortable and intractable complication. The leakage may diminish somewhat, but healing never takes place. In one case (No. 26) an attempt has recently been made to remedy the defect by converting the vagina into an annexe of the bladder. The fistula, however, was so close to the urethral orifice that control has not been established. One patient (No. 36) is dry while lying in bed at night, but constantly leaks during the day. It is particularly with regard to this unhappy occurrence that careful selection should be exercised in the choice of case. In considering the question of fistula formation it must not be forgotten that the condition must inevitably arise in a large number of cases as a direct result of the disease. Thus, Leitch, in his series of 915 end-results of inoperable cases, records 44·2 per cent. of vesico-vaginal and 16·5 per cent. of recto-vaginal fistulæ.

TABLE I.

Traced and died	29	Operation abandoned	2
Untraced	5	Living	7

TABLE II.

Not Discharged.—Died in hospital, 8 (average 3½ months).
Readmitted.—Died in hospital, 4 (average 1 year 8 months).
Discharged.—Died outside, 17 (average 1 year 4 months).

TABLE III.

No.	Name	Age	Duration of life	No.	Name	Age	Duration of life
1	F. B.	65	1 year	23	C. A.	40	1 year 2 months
2	N. T.	49	Not traced	24	M. E.	34	2 months
3	J. M.	42	7 months	25	F. B.	68	3 years 1 month (l.)
4	H. P.	41	Not traced	26	E. G.	34	10 months
5	E. S.	47	Not traced	27	F. D.	53	9 months
6	E. S.	54	1 year 4 months	28	K. B.	41	2 years 10 months (l.)
7	K. H.	51	2 years 2 months	29	E. J.	46	2 weeks
8	M. S.	58	1 year 3 months	30	M. D.	32	2 years 5 months (l.)
9	F. F.	51	1 year 3 months	31	H. C.	?	3 years 4 months
10	M. S.	28	1 year 3 months	32	M. N.	40	1 year 3 months
11	R. K.	50	4 months	33	J. G.	55	Not traced
12	M. M.	31	Not traced	34	S. C.	56	11 months
13	F. L.	56	9 months	35	I. W.	47	1 year (l.)
14	E. S.	39	7 months	36	R. W.	51	1 year 3 months (l.)
15	M. A.	56	1 month	37	M. S.	39	1 year 5 months
16	M. D.	57	2 years 6 months	38	C. K.	67	8 days
17	E. R.	66	2 years 8 months	39	E. G.	34	8 months
18	E. P.	47	2 years	40	S. F.	43	5 months
19	M. R.	51	Died same day	41	M. N.	40	3 months
20	A. M.	40	9 months	42	M. G.	46	9 months (l)
21	F. K.	48	1 year 8 months	43	H. W.	?	2 months (l.)
22	A. W.	66	3 years 2 months				

(l.) = living.

CONSIDERATION OF RESULTS OBTAINED.

The best estimate of the results will be obtained by considering separately the categories indicated in Table II. The first group—those not discharged from hospital—includes four cases who died within a month after operation, and this may be regarded as the primary mortality. The other four cases, although the patients lived for periods of from two to ten months, were confessedly failures in so far that no claim is made that any definite benefit was conferred upon them. The second group deals with four cases who were readmitted and died in hospital. These were Nos. 7, 13, 22, and 27. The cause of death was as follows:—

Case 7 was seen as an out-patient six months after operation. She had then no discharge nor pain, and had gained weight and strength. She was readmitted one month before she died on account of occasional hæmorrhage noticed for two months previously. Radium was embedded; this was followed by hæmorrhage, and she died of uræmia. This patient had two years of life free from symptoms, and enjoyed good health throughout that time.

Case 13 was an utter failure. She was admitted for colostomy, and died as a result of the operation.

Case 22 was readmitted after three years for radium implantation, recurrence having given rise to some blood-stained discharge. Before any treatment could be carried out she developed intestinal obstruction, from which she died.

Case 27 was quite well until immediately before readmission. She was admitted for hæmorrhage, from which she died three weeks after.

The average life duration in this group is twenty months, and three of the patients were undoubtedly benefited very considerably. The third group includes those patients who were discharged from hospital, were never readmitted, but died outside the institution. For the after-history of these cases we have had to depend upon the out-patient notes and answers to inquiries made by post. Out-patient notes on many of the cases do not exist, as so many of these cases have been admitted from places a long distance from the hospital, and this has precluded their further attendance. Answers to inquiries have been disappointing, largely owing to the lack of education among the patients and their friends. In many cases nothing more than the date of death was indicated.

NOTES ON CERTAIN CASES.

A few notes obtained on some cases may serve to indicate the relief, or otherwise, afforded. These notes, culled from the sources above indicated, are given without selection.

Case 1.—Seen as out-patient eight months after operation. Uterus freely movable, slight bleeding on examination, no ulceration, some right-sided pain, diagnosed elsewhere as appendicitis. Cause of death unknown.

Case 6.—Seen five months after operation. No discharge, no hæmorrhage, some pain radiating down the left leg. Died sixteen months after operation. Cause of death unknown.

Case 10.—Was discharged from hospital free from symptoms—no discharge, no hæmorrhage—greatly improved in health. Died fifteen months after operation. Cause of death unknown.

Case 18.—Seen three months after operation and noted as an excellent result in every way. Eight months after operation small local recurrence noted. Attended out-patients, to within two months of her death, which was determined by hæmorrhage two years after operation.

Case 23.—Seen seven months after operation and stated "that she never felt so well." Ten months after operation began to lose weight. This was shortly followed by polyuria. Died fourteen months after operation from hæmorrhage.

Case 32.—Seen two months after operation and noted as being better in every way. Seen again six months after operation, when there was no sign of malignancy locally, but it was noted that she had free fluid in the abdomen. This patient died fifteen months after operation from diffuse malignant peritoneal invasion.

Case 40.—Lived only five months, and although free from symptoms, never recovered her health. No definite cause of death is known.

Case 41.—Lived only three months. No definite cause of death known, but was free from discharge, hæmorrhage and pain.

The average duration of life in this group was sixteen months. All patients discharged were immediately relieved of all symptoms, and, basing our deductions upon known histories, it would appear that death usually ensues very soon after the onset of any symptom indicating renewed growth.

Leitch gives twenty-one months as the average duration of life from the commencement of the disease, as determined by the date of the exhibition of the first symptom. Every case in my own series has been pronounced inoperable, and in many cases application for admission was not made until the lack of facilities at home forced the patients to seek institutional aid. Again, varying periods necessarily elapse between application and actual admission. In view of these considerations, it is not, I think, unfair to estimate that the average expectation of life could not have exceeded six months.

A better idea of the economic value of the increased term of life thus conferred may perhaps be gathered from a consideration of the cases—seven in number—still living. These are Cases 25, 28, 30, 35, 36, 42, and 43. Of these, Case 43 has been operated on only two months, and may be excluded from consideration. To take these cases separately:—

Case 25.—This patient, seen on November 24, 1920, was in perfect health. She is able to live a normal life and to do quite as much as any normal person of her years. She has a vesico-vaginal fistula, and is compelled to wear a urinal, but she has no discharge, hæmorrhage, or pain, and shows no sign of any malignancy.

Case 28.—For two years this patient was absolutely free from any symptom associated with malignant disease of the cervix. She was normal in every way and in perfect health. Since then she has had several severe hæmorrhages and has been treated consistently with X-rays. Between her admissions to the hospital she gets about, but her life for the last few months cannot be regarded as of economic utility.

Case 30.—I saw this patient on November 24, 1920. She lives in Bedfordshire and walked five miles to the railway station. She has a husband and two children, the youngest being 4 years old. Her husband has been receiving a pension of only 25s. a week, and she has been enabled to go to work and be largely instrumental in keeping the family. She was only aged 32 when subjected to operation. She looked well and is well and strong, and exhibited no indication of malignant disease. This is the most strikingly successful case in the series.

Case 35.—This patient has a vesico-vaginal fistula and wears a urinal. She was admitted to hospital again in November, 1920. The closure of the fistula was impracticable, due to small recurrence close to its margin. Three radium needles were embedded. She had no discharge, no hæmorrhage, and no pain, and both looked and felt well. This case was, at the time of operation, noted as being particularly unsuitable.

Case 36.—This patient, although free from discharge and hæmorrhage, has been a more or less chronic invalid. She was admitted in August, 1920, for radium embedding, but refused treatment. The operation was performed fifteen months ago.

Case 42.—I saw this patient on November 24, 1920. She was then in splendid health and showed no evidence of malignant disease. This case was remarkable from the fact that, in addition to the primary growth at the cervix, she had a large secondary mass at the vaginal outlet. This was removed with a knife, and the area freely treated by diathermy. The mass was submitted to the pathologist, who reported it to be a secondary epithelioma. The first operation was undertaken in January, 1920.

Remarks.

The penetrating power of the low heat advocated by Percy and the alleged vulnerability of cancer cells to a degree of heat insufficient to destroy the vitality of normal tissue cells are questions which existing data do not suffice to decide. Boldt [3(9)] relates the result of a post-mortem on one case soon after operation, and concludes that Percy's contentions are thereby refuted. It is, however, not intended to institute a comparison between the cautery method and the radical panhysterectomy. It is frankly recognized that the operation is palliative and should be reserved for advanced cases, or for cases in which radical operation is deemed unsuitable. To this extent, then, it may be fairly regarded as a rival to treatment by radium. It is not my purpose or desire to institute such comparison, for of late I have learned to regard them not as rivals, but as partners. It must be openly confessed that a number of cases in this series have failed, and that failures must be expected in a proportion of cases varying with the amount of selection exhibited. It must be remembered, however, that the condition of the patients in this series could with difficulty be made worse, and that to that extent any relief obtained is to the good. Bearing these facts in mind, and with a determination to combat discouragement, it might, I think, fairly be taken that this operation, particularly when reinforced by consequent radium treatment, should have a place in the armamentarium of a surgeon who would endeavour to undertake the treatment of inoperable cancer. With the cautery and radium together, used discreetly and discriminately, a great deal may be done, perhaps more than has been done, to alleviate the distressing disabilities of inoperable uterine cancer, and in many cases to restore to those suffering derelicts peace of mind, together with the chance of an increased term of economically useful life.

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DISCUSSION.

Mr. O. T. Dinnick said that after more than six years' experience he was an enthusiastic advocate of the cold cautery in cases of inoperable uterine cancer. It was now possible to give immediate and appreciable relief, and often a lengthy reprieve in these cases. This, he believed, had not yet been possible by any other palliative method. It was important to distinguish between the actual cautery and the cold cautery. The one employed a very high heat, the other a comparatively low one; in one the action was sharply localized, in the other diffused. The action of one was escharotic, that of the other coagulant. One destroyed all tissues, the other appeared to select the carcinoma cell—of great proliferative activity but poor vitality. The use of the actual cautery was followed by a comparatively slight connective tissue reaction; the cold cautery always stimulated dense fibrous tissue formation. Wassermann had shown that mouse carcinoma could not survive 115° F.—not a very high temperature. It was this mild heating effect, long continued, which was the desired end in applying the cold cautery. Cancer of the uterus was seldom recognized before ulceration occurred, and in over 70 per cent. of cases death occurred before the disease had spread beyond the brim of the true pelvis. Death in uterine cancer was due to three concomitant causes—bleeding, sepsis, and uræmia. In cases of uræmia due to ureteral compression the cold cautery was useless. Perhaps the time would come when ureteric transplantation would give patients in these cases a new lease of life. The best effects of the cold cautery were obtained in the cases of bleeding and sepsis. In operating on these cases he had been impressed by the great frequency of associated pyometra with uterine cancer. The relief to the patient was much more real than could be shown by Mr. Cole's figures, for the clinical benefits had to be seen to be appreciated. Mr. Dinnick believed the method was justified, and that an increasing knowledge of its benefits would lead to a wider application. Its use required time, and perhaps the fact that the ligation of the iliacs was a necessary preliminary would take it out of the hands of the occasional operator. Its immediate safety, wide applicability, the absence of shock and of post-operative complications and the immediate relief were very striking facts. The only drawback at present would appear to be the number of post-operative vesico-vaginal fistulæ in the earlier series. Increasing experience, and a modification of the instruments used, would, he felt sure, greatly diminish their appearance in future cases.

Dr. ARTHUR GILES said that any method proposed to benefit sufferers from inoperable carcinoma of the cervix should receive careful consideration; but the results should be compared with those of older methods. The treatment described by Mr. Cole had two serious drawbacks: one the immediate risk, which was appreciable; the other the danger of damage to the bladder. Seven cases of vesico-vaginal fistula out of forty-three cases represented a very high proportion of a complication which entailed a great deal of discomfort and distress. A method of treatment that he had employed for many years in inoperable cases consisted in scraping away as much of the growth as possible, and packing the resulting cavity with gauze soaked in a saturated solution of chloride of zinc. A quantity of bicarbonate of soda powder was then thrown into the vagina, with some loosely packed gauze, to absorb any excess of the chloride of zinc and thus avoid injuring the vagina. There was no risk in this method, and he had never known it to be followed by a fistula. Though he had not precise figures available, he was under the impression that the expectation of life after this treatment would compare favourably with that following the cold cautery method. He could recall at least one case in which the patient remained in good general health and free from symptoms for over three years after the treatment by chloride of zinc.

Dr. H. SPENCER said that he had had the advantage of seeing Dr. Percy operate on the first two cases at the Cancer Hospital and of examining two of Mr. Cole's cases that night. One of these had a fistula and the tissues felt *per rectum* were so indurated that it was not possible to say there was no recurrence, although three years had elapsed: the other after one year seemed to be free. In any case there was no doubt that the patients had benefited. He could corroborate Mr. Cole's statement as to the frequency with which pyometra was met with in these cases. With regard to the preliminary preparation the curette was much inferior to Doyen's cutting forceps which dispensed with the use of a volsella, which might easily lead to implantation. The somewhat high mortality of the Percy method and the frequent occurrence of fistulæ were important drawbacks in a palliative operation. And it was curious that none of the cases were operable cases. In these respects the Percy method appeared to be inferior to radium treatment. He preferred to the cool cautery the hot kitchen poker as a palliative measure, and the hot electric or Pacquelin cautery as a curative measure, of the efficacy of which he would show an example that night.

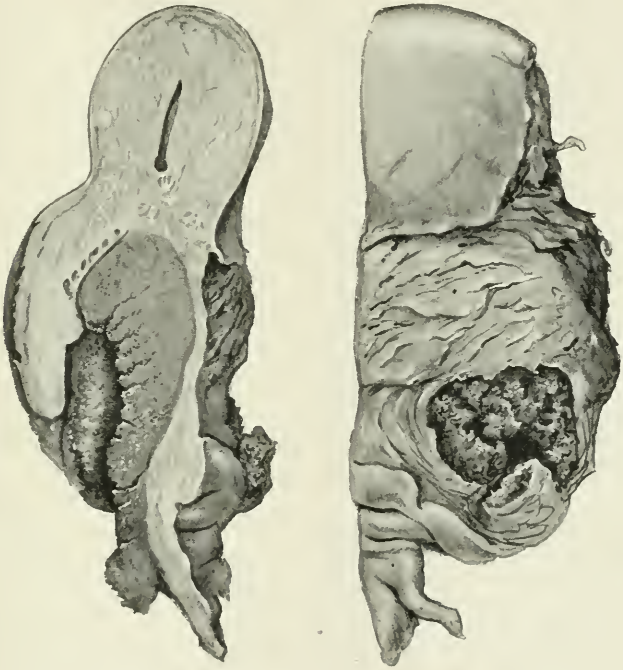
Extensive Cancer of Cervix: Removal by Vaginal Hysterectomy with the Cautery and Ligaments cauterized.

By Herbert R. Spencer, M.D.

The specimen was removed by vaginal hysterectomy with the cautery on November 5, 1908, from a lady aged 60 (less four days), the mother of two children, who was sent to me by Mr. E. A. Barton. She was nervous and stout, and a bad subject for abdominal hysterectomy. The body of the uterus (*see* figure) is atrophic but slightly distended by a hydrometra. The cancer extends upwards to the internal os, downwards anteriorly on to the vagina, and outwards greatly distends the cervix within the broad ligaments, especially on the left side, where it is covered with but a thin shell of tissue, which tore during the removal. As it appeared that a thin shell of tissue had been left behind, a thick kitchen poker, heated to a dull-red heat, was applied to the broad and utero-sacral ligaments, which had been felt before the operation to be thickened.

The patient made a simple recovery and has had no trouble since. I saw her in excellent health in November, 1920, on her seventy-second birthday, more than twelve years after the operation.

I prefer a thick kitchen poker heated to a dull-red heat and passed through a wooden speculum to the electric or Pacquelin's cautery for the destruction of cancer, owing to the pressure which can be made with it and the massive heat it supplies. I have also used for the purpose of preventing implantation the electric cautery heated to incandescence so intense that in some cases the pelvic fat was melted and the oil, set alight, flashed in the pelvis, giving a momentary flame of slight heat intensity. I am so much impressed with the value of heat in preventing local implantation (as shown by the rarity of recurrence *in the vaginal scar* in my cases) that in future I intend to apply the slight heat of the flame of a spirit lamp to all raw surfaces.



The PRESIDENT said that in assessing the degree of success or failure in the surgical treatment of cancer of the cervix, there was generally a gross understatement of the total duration of the disease. The hair-breadth limit of healthy tissue which Dr. Herbert Spencer had mentioned was to an operator more fearful than prohibitive. The President had followed the late Mr. Edward Bickersteth's lead and removed the growth whenever he could get round it. In inoperable cases the direct application of liq. calcis bisulphitis, 1 in 8, on lint as a water dressing was still a favoured remedy in Liverpool.

Section of Obstetrics and Gynæcology.

President—Mr. HENRY BRIGGS, F.R.C.S.

An Unusual Type of Tuberculous Peri-tubal Cyst.[1]

By F. C. PYBUS, M.S. (Newcastle-on-Tyne).

THE patient, H. F., aged 20, in August, 1918, noticed that her abdomen was beginning to swell. She had little or no pain, and, after some treatment by her doctor, was admitted two months later to the Royal Victoria Infirmary as a case of tuberculous peritonitis with ascites.

Laparotomy was performed through a small subumbilical incision. Some ascitic fluid was removed and the abdomen washed out with saline and closed. No note was made as to whether the intestine was seen, or if seen, as to its condition. Recovery from the operation was uneventful. Within four months the abdominal swelling had returned and reached such a size that she was unable to go out. At this time she had no other symptom except constipation.

Her treatment seemed to present great difficulties as she was successively under her own doctor, the tuberculosis officer, and was later admitted to the medical ward, from which she passed to the surgical.

While on the operating table I was asked to carry out her operation, and found an abdomen containing fluid with a scar of a previous laparotomy. The abdomen was reopened and a large amount of straw-coloured fluid evacuated. Later some flakes of lymph floated out, and later still the fluid showed some turbidity.

On my wishing to inspect the viscera, none could be seen, and on inserting my hand into the abdomen, it entered a large cyst with a smooth, but non-glistening wall, which extended from the depths of the pelvis to the upper abdomen. At the bottom of the cavity two papillomatous masses were found projecting into the cyst, and the first conclusion come to was that the cyst was a large papillomatous ovarian which had "lined out" a large part of the peritoneal cavity, although this seemed unusual, as there were no smaller growths scattered about the inside of the cyst.

On making the abdominal incision it had been noted that the supposed peritoneum was some $\frac{1}{4}$ in. thick, and had rather a laminated appearance. Attention was now directed to this apparently thickened peritoneum, which was found to strip, and which was recognized to be in reality a cyst wall. The stripping was continued, and the cyst wall separated from the anterior and lateral abdominal wall, liver, stomach, omemtum, small intestine, and colon without very much difficulty, but leaving a rough, slightly bleeding surface. On tracing the cyst wall into the pelvis it was peeled from the bladder and uterus, and the two papillomatous masses were found to be the enlarged fimbriated ends of the Fallopian tubes which projected into the cyst, the entering portion being incorporated in the wall. The cyst, having been completely separated except where the tubes entered it, it remained necessary to amputate the distal half of each tube just beyond its entry into the cyst. The ovaries lay outside the cyst wall and were conserved.

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[1] At a meeting of the Section, held February 3, 1921.

The patient made a normal recovery, and now in December, 1920, is in good health, and has no trouble except some menorrhagia for which treatment is being commenced. If drugs prove futile, it is proposed to curette the uterus, when the scrapings will be submitted to microscopic examination.

On examination the specimen (which unfortunately has since been mislaid) was found to be composed of a cyst wall some ¼ in. thick with roughish outer and inner walls. Projecting into it at the base and separated by a distance of 2 in. were the fungating fimbriated ends of the Fallopian tubes, greyish-yellow in colour, about the size of a hen's egg. On the outer aspect, the cut end of each tube could be seen passing into the cyst.

A section of the cyst wall and papillary mass showed that each were tuberculous.

Whether the cyst was the result of a primary tuberculous peritonitis with encapsulation, involving the tubes, or whether of a primary tuberculosis of the Fallopian tube with pelvic encapsulation and gradual expansion into the abdominal cavity, it seems very difficult to determine with certainty, but I incline to the latter view, a point in favour of which is the fact that the ovaries, though attached to the cyst wall, escaped involvement in its cavity.

(Microscopic slides of (1) section of cyst wall, and (2) section of fimbriated end of Fallopian tube were shown.)

A Record of Seventy-six Cases[1] of Uterine Fibroids and Chronic Metritis treated by X-rays.[2]

By T. Watts Eden, M.D., and F. Lionel Provis, F.R.C.S.Ed.

This paper is a record of forty-six cases of uterine fibroid tumours and thirty cases of chronic metritis treated by us with X-rays during the years 1914 to 1920 inclusive. All the cases were under the personal supervision of one or other of us throughout treatment, and the X-ray exposures were in every case made by one of us (F. L. P.). A large proportion of the cases were patients seen in private practice. Three have died from independent causes since treatment, and we have been able to obtain reports as to the present condition of all but fourteen cases, at intervals varying from three months to six years after the treatment. A brief epitome of selected cases will be given later on in the paper. Of the forty-six cases of fibroid tumour thirty were married, fifteen were single; of the thirty cases of chronic metritis twenty-five were married, five were single. With regard to age, it may be said that eight cases were between 36 and 39 inclusive, the remainder from 40-56 inclusive; the proportion of cases below 40 was therefore small—viz., about 10 per cent.

Selection of Cases.

The first point to which we wish to direct attention is the method of selection for X-ray treatment. Not all cases are suitable for this treatment, and at first we had to feel our way with some caution. The points which bear upon selection are: (1) age of patient; (2) size of tumour (if a fibroid);

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[1] The complete record of the cases is preserved in the Library of the Royal Society of Medicine.

[2] At a meeting of the Section, held February 3, 1921.

(3) character of hæmorrhage; (4) degree of anæmia; (5) presence of complications, such as inflammatory disease of the appendages, degeneration of a fibroid tumour, &c.

(1) *Age.*—We have rarely (in only eight cases) treated patients under 38 years of age with X-rays; the effect of the rays is exerted primarily upon the ovaries, resulting in destruction, more or less complete, of the active ovarian tissues. Preservation of the ovarian secretion in women under 38 is of great importance, but as the age of the climacteric approaches its importance becomes less.

(2) *Fibroids.*—Fibroid tumours which exceed the level of the umbilicus in height we have, generally speaking, rejected. Nearly all fibroids shrink materially in size after exposure to X-rays, but the shrinkage of large tumours may not be sufficient to relieve mechanical symptoms. We have found that while, in such cases, it may be practicable to induce complete amenorrhœa, the tumour may cause so much discomfort from its bulk that only partial relief of symptoms is obtained.

(3) *Hæmorrhage.*—The character of the hæmorrhage is important when it raises the suspicion of malignancy. If the type of menorrhagia is not maintained, and irregular or interval-bleeding is present, the uterus should be first explored to exclude carcinoma of the body.

(4) *Anæmia.*—As will appear later, the first treatment, or the first and second treatments, may be followed by increased, and even by much increased bleeding. In the case of a patient profoundly exsanguine from repeated hæmorrhages it is therefore preferable to advise hysterectomy (vide Case 75).

(5) *Complications.*—Only simple and uncomplicated cases are suitable for X-rays. A careful examination of the cervix was made in every case, to exclude appearances suggestive of a malignant growth. The presence of pain is a symptom which requires careful investigation; tenderness or rapid increase in size of a fibroid suggest degenerative changes; limitation of mobility or the presence of a tender swelling on either side of the uterus, or on both sides, suggests inflammatory disease of the appendages. Any of these conditions, if present, render the case unsuitable.

It will therefore be evident that we have not used X-rays as a general substitute for hysterectomy, but have, on the contrary, limited its application to carefully selected conditions: and the cases treated have, in fact, constituted only a small proportion of the cases of fibroid tumours and of chronic metritis which have come under our notice in the period under review. We hold strongly that the indiscriminate treatment of these conditions by X-rays is a mistake; every case so treated should first be passed as suitable by a competent authority.

With regard to the cases classed as "chronic metritis," it must be said that in every instance the diagnosis was clinical only; if no marked enlargement or irregularity in outline of the uterus could be made out the local condition was for convenience labelled "chronic metritis." In many of the cases the diagnosis was supported by the fact that curretting had been previously performed without relief.

TECHNIQUE.

The technique adopted in the majority of cases was a modification of that used in Krönig's clinic at Freiburg, the principle of which is the administration of massive doses of X-rays in the shortest possible time commensurate with safety as regards the skin of the areas irradiated. In a few cases the total dose has been reduced by diminishing the number of areas irradiated at each treatment, and it is noteworthy that the cases so treated comprise the greater proportion of the failures in our series. They frequently showed a recurrence of hæmorrhage after a period, varying in duration, of amenorrhœa. These two facts support the conclusion we have come to from our experience—namely, the importance of giving massive doses and the administration of the treatment for one or two sittings after amenorrhœa has been induced.

In describing the technique it is not intended to go into the details of the technical side of the running of an X-ray tube. This part of the technique requires special knowledge, and a lengthy description of the various apparatus used in the successful manipulation of an X-ray tube for deep-seated therapeutic purposes. We will therefore only deal with that part of the technique with which the clinician of to-day should be conversant.

The tubes used have been of the water-cooled variety, equipped with osmo regulators, by means of which the hardness of the tube can be regulated. They are maintained at a hardness of 8 to 9 Bauer with an equivalent spark gap of 8 to 9 in., with the passage of 2 to 3 ma. through the tube circuit. The rays are filtered through a 3 mm. aluminium filter, which cuts off all but the hardest rays emitted from the tube. Further filtration is provided by placing between the aluminium filter and the part to be irradiated a loofah sponge enclosed in chamois leather, together with four layers of satrap paper, all of which are enclosed within a linen bag. These measures seem adequately to protect the skin from any injurious effects. The tube is fixed in a suitable stand, the box of which can be moved up and down and fixed at any required angle by manipulation. A wire connects the tube-stand to the earth.

The patient is placed on a suitable couch and the lower abdomen from the level of the umbilicus laid bare. Over this area eight or six square areas are marked out with a coloured pencil, which constitute eight or six ports of entry for the irradiations. Each area is irradiated separately, and is enclosed by two lead angles which are so placed that only the field to be irradiated is left exposed. Over that area is placed the linen bag containing the loofah sponge, chamois leather, &c., already mentioned. On the top of this is placed a sheet of lead rubber in which is cut a square window, and through this the rays pass to the exposed area of the abdomen. In the centre of this square area resting on the linen bag is placed a Kienböck photographic paper, a strip of bromide of silver paper, which when developed acts as a rough guide to the amount of X-rays administered. The tube is now placed in position, the tube-box being adjusted in such a manner that the anti-cathode of the tube is in line with the centre of the square of the exposed area, and at such an angle that the rays pass down into the pelvis. Each area is irradiated for ten minutes.

This concludes the treatment given on the first day, for the remainder of which the patient is ordered to bed. On the following day, with the patient lying prone, four areas are marked out over the sacral and sacro-iliac regions, and each irradiated for ten minutes. The same protective measures, &c., are used as those described when irradiating the abdominal areas. Each "treatment" comprising the exposures on the two consecutive days lasts some three or four hours and comprises one attendance on two consecutive days, the abdominal areas being irradiated on the first day and the sacral areas on the second day. The patient is ordered to bed after the treatment on the first day, but this is not necessary in the majority of cases following the sacral exposures.

An interval of three weeks is allowed to elapse between each treatment as a precautionary measure against injury to the skin. The time selected for administering the treatment should be shortly after the termination of a period. If given immediately before the onset of menstruation it is likely to increase the hæmorrhage rather than to diminish it, especially in the early treatments. The requisite number of treatments will be found to be from four to six, and one treatment at least should be given after amenorrhœa has been induced. Many factors, however, have a bearing on the number of treatments required, and in certain cases a modification of the technique here described may be advantageously adopted.

DOSAGE.

We now come to the important consideration of the estimation of dosage.

It will have been observed in the summary of the cases no mention of dosage has been made, but that in its place the total time exposure of each case has been given. The reason for this is that none of the many methods devised for the estimation of dosage possess even approximate accuracy. The so-called dosage each area is to receive must in the present state of knowledge and with the existing methods used in estimating the same be left to the judgment of the operator. He will give to the patient that amount of X-rays that he knows can be given with safety, gauged by the characteristics of the tube and the number of milliampères passing through it, the reading on the Bauer qualimeter and the length of the equivalent spark gap, controlled by one of the methods devised for estimating the dosage through the discoloration of pastilles or photographic paper after it has been developed. In other words, given certain working data the operator knows for what length of time he can submit his patient to irradiation without inflicting any damage: but to say he can administer such and such a dose of X-rays to each ovary is not practicable. Much work has been done, and is being carried out at the present time, to devise some means of recording the accurate dose of X-rays administered, but the difficulties of this problem are very great, and until we have some fairly accurate method of measuring the dose the patient receives it appears to us a wiser plan not to speak of some imaginary dose the patient is supposed to have received, but to express the dosage in terms of time exposure.

EFFECTS OF X-RAY TREATMENT.

We now come to describe the effects of the treatment as we have seen them in our series of cases.

Mode of Action.—It will be sufficient to remember that the outstanding effect of the rays is exerted upon the ovaries, leading to destruction of the follicular and interstitial elements, and eventually to complete fibrosis of the organ. At the same time a very marked and rapid shrinkage occurs, as a rule, in the fibroid tumour, up to complete disappearance in some instances. The tissue elements of the tumour are certainly absorbed, and we believe that this must be due to some process analogous to autolysis. It may be that under the influence of X-ray irradiation ferments are produced locally which are active as against the elements of the tumour, but inert as against those of the normal tissues. Inasmuch as the operation of double oöphorectomy for fibroids as formerly practised seldom resulted in any marked degree of shrinkage of the tumour, it is reasonable to conclude that this reduction in size of the fibroid is largely due to the rays, not to the elimination of the internal ovarian secretion.

Effect on Menstruation.—We have succeeded in all but five cases treated by X-rays either in inducing complete amenorrhœa or in so reducing the frequency and the severity of the losses as to relieve symptoms completely. The dose required, as estimated by the time exposure, varied very much, the limits being two hours twenty-seven minutes and fifteen hours thirty-five minutes. The longest exposures (those over ten hours) were all given in cases of fibroid tumours; on an average it may be said that cases of chronic metritis require a smaller dose to produce amenorrhœa than do fibroids. We cannot find in our cases that the age of the patient has any bearing upon the dose required, although we anticipated in starting our work that the younger ones would require the larger doses.

The initial effect upon menstruation is often to increase the amount of the flow. This often occurred after the first or second treatment. On the other hand, the first exposure is sometimes followed at once by marked diminution of bleeding, shown by absence of clots, or by a prolonged inter-menstrual interval. The early increase in menstrual losses is probably brought about by a stimulation of the activity of the ovarian tissue representing the first effect of a small dose of the rays. As the effects of the rays are continued, stimulation of ovarian tissue is replaced by a reverse action which ends in complete destruction. In the case of fibroid tumours we have several times noted the occurrence of a slight, continuous, blood-stained discharge for some weeks after menstruation proper had ceased. This is probably associated with the changes in the tumour which result in shrinkage.

There were in all ten cases in which we did not succeed in inducing complete amenorrhœa—five fibroids and five chronic metritis. In three of the ten cases the losses continued to be severe and the patients were eventually operated upon. The details (Nos. 8, 12, and 76) will be found in the account of selected cases at the end of this paper. Another patient (No. 41) refused to continue the treatment, which, if persisted in, would probably have been successful. In another case (No. 29) the treatment, although thoroughly tried, also failed to reduce the monthly losses except temporarily. This patient still refuses operation, and her case must also be classed as a failure. If No. 41 be eliminated there remain four cases out of seventy-six—i.e., $5\frac{1}{4}$ per cent.—in which we failed to produce any lasting effect upon menstruation. All four were cases of fibroid tumour, and accordingly the percentage of failure in cases of fibroid tumour works out at 8·7 per cent., while in cases of chronic metritis there was no failure at all.

Cases in which Menstruation was Controlled but not Suppressed.—In five cases a very interesting result was obtained, for, without suppressing menstruation altogether, the treatment so far controlled it that symptoms were entirely relieved without actually inducing the menopause. These cases are numbered 39, 49, 56, 65, and 70; the first a fibroid, the others chronic metritis. A typical example of this class is case No. 39, a patient, aged 45, with a fibroid tumour extending nearly to the umbilicus. After prolonged treatment she still has a moderate period about twice a year, there are no menopause symptoms, her general health is good, and the tumour is about two-thirds of its size before treatment. The most striking example of all is No. 70. This was a patient aged 40, classed as chronic metritis, with a history of menorrhagia for two and half years before treatment. After five treatments she had four months amenorrhœa; then the periods returned, normal in amount and duration. She has continued to menstruate normally for four years and nine months—i.e., up to December, 1920—the date of the last report.

Such effects as these are probably to be explained by assuming that a varying resistance is offered to the rays by ovarian and uterine tissues. The active ovarian elements may perhaps be put out of action by the rays for a more or less prolonged period and then recover some of their functional potency, or the destruction of these elements by the rays may be incomplete, sufficient follicular tissue escaping to induce occasional menstrual periods. Or again, changes may be induced in the uterus which tend to control menstrual hæmorrhages.

Partial suppression of menstruation is not to be regarded as a failure. It would perhaps be right to regard the ideal dose of X-rays as that which suffices to confine the monthly losses within normal limits, rather than that which suppresses them altogether. In the present state of uncertainty as to the estimation of dosage the attainment of such an ideal seems impracticable, but our experience leads us to believe that by careful graduation of time-exposures we may be able to reduce excessive monthly losses, or to induce partial amenorrhœa, with the same degree of certainty as we can now induce complete amenorrhœa.

GENERAL EFFECTS OF X-RAYS.

The immediate effects produced by the prolonged exposures we used were not constant. The majority of our patients suffered more or less from fatigue, which lasted for two days or more, and which led us to advise that after the X-ray exposure the patient should go to bed for the remainder of the day. In one or two cases rather marked prostrations occurred. In a few instances, on the other hand, the rays appeared to produce a stimulating effect, the patient feeling all the better for it.

LOCAL EFFECTS.

Skin.—The areas exposed to the rays always show immediately afterwards a more or less marked flush, which is later replaced by brown discoloration or pigmentation. No soreness nor irritation occurs in connexion with this change, and after treatment has ceased the pigmentation very gradually disappears. In three cases a mild dermatitis occurred during treatment, which was in consequence interrupted for a time. There was no loss of tissue and very little pain accompanying it; in the worst of the three treatment was suspended for six weeks and was then resumed without any further trouble. We have had no case in which skin trouble has developed subsequent to treatment.

The Uterus in Chronic Metritis.—Our impression from bi-manual examination made at varying intervals after suppression of menstruation is that a definite reduction in size occurs in the uterus coincident with the suppression of menstruation.

Fibroid Tumours.—Definite shrinkage of the tumour followed the suppression of menstruation in all of our fibroids treated except four. The shrinkage is fairly rapid and can be followed during the treatment. In three instances we have noted the practically complete disappearance of a small fibroid tumour, the size of a three months' gravid uterus, in less than a year. By "practically complete disappearance" it is meant that nothing remained except one or two small surface nodules suggestive of subperitoneal fibroids, the uterine body being otherwise of approximately normal size. The majority of the cases in which this marked shrinkage has occurred have been examples of small tumours not exceeding the size of a three and a half to four months gravid uterus. In three cases, however, we have seen a fibroid reaching as high as the umbilicus disappear entirely with the exception of one or two nodules

(Cases 23, 31 and 38). The maximum shrinkage appears to take place in from six to twelve months in tumours not exceeding the size of a three to four months pregnancy, and in from twelve to twenty-four months in tumours larger than this.

Pelvic and Abdominal Viscera.—In addition to the effects described upon the uterus and the ovaries, we have been unable to detect any influence upon the other pelvic viscera except possibly in one case recorded fully below (Case 59). We have paid careful attention to the mobility of the pelvic organs before and after treatment, and except in this doubtful case we have never found after the X-ray treatment that any tenderness or loss of mobility was manifested, in fact, nothing whatever to suggest that any local inflammatory changes were induced by the X-rays. In a few cases nausea was complained of for one or two days after each treatment; in one case (Case 1) nausea was very severe and lasted for several days after each treatment, during which the patient could take no food. On one occasion the same patient suffered from severe diarrhœa after a treatment. For over two years since then she has been in good health and is habitually constipated. Whether these effects should be attributed to a direct action of the rays on small intestine or other viscera we are unable to say. In two or three of our cases a little looseness of the bowels was noticed for a few days after treatment.

POSSIBLE RISKS OF INJURY BY X-RAYS.

This leads us to the question, Is there any risk that injury may be done by X-rays to the skin or to the pelvic and abdominal viscera? With regard to the skin, we have had two cases only of slight dermatitis, both of which cleared up without ulceration; there is no doubt that by efficient filtration and protection the skin can be adequately guarded. The question of the possibility of injury to such organs as the intestines cannot be so readily answered, as they are not under direct observation. Cases of X-ray ulceration of the small intestine have been recorded in France and Germany, and in view of the frequency with which coils of jejunum are found lying in the pelvis they may, of course, be subject to irradiation along with the other pelvic contents. No such case has occurred in our series, but we have had one case which was operated on for pelvic inflammation eight months after the cessation of treatment, and terminated fatally. We believe the condition was in reality due to an acute ascending infection which arose after the X-ray treatment was concluded. Definite proof is, however, wanting; we therefore lay the facts of this case before the Section, as this is the only one in our series in which any suspicion could arise that injury had been caused by the X-ray treatment.

Case 59.—Married, aged 43; children three (April 1, 1914). Symptoms: Menorrhagia of two years' duration. Local conditions: Chronic metritis, uterus enlarged; mobility of uterus impaired; no evidence of tubal inflammation.

Treatment: Total exposure 5 hr. 20 min. in five treatments, April to July, 1914.

Effects on menstruation: Complete amenorrhœa from June, 1914. General effects: General health improved, but symptoms of intestinal irritation commenced with diarrhœa and some abdominal pain. (September, 1914.) These symptoms continued and the patient was admitted to Chelsea Hospital for Women in March, 1915, eight months after the last X-ray treatment, not having been seen by me (F. L. P.) since the previous September. She was then found (*per vaginam*) to have a tender mass filling Douglas's pouch and extending into both sides of the pelvis, especially the left. The motions were fluid, containing small amounts of fæcal matter, but no mucus or blood, attacks of constipation and diarrhœa alternating.

March 23, 1915: Laparotomy performed. An inflammatory swelling was found filling up the pelvis, shut off from general abdominal cavity by adhesion of bowel and omentum, which were separated. Uterus adherent to rectum; both tubes inflamed, the left containing about a teaspoonful of pus. On separating uterus from rectum pus escaped which was loculated between the two organs. An opening was at this stage discovered in the rectal wall; whether it was caused by separating adhesions or whether it was an old opening communicating with an abscess cavity could not be decided. There was a great deal of perirectal inflammation. The left tube was removed. The hole in the bowel was closed with great difficulty and the uterus lightly sewn over it. A gauze drain was inserted and the abdomen closed. By an incision in the left inguinal region a portion of the descending colon was brought out of the abdominal cavity and a roll of gauze pushed through the mesentery to secure it in position, and a few stitches fixed the bowel to the inguinal incision. The colotomy was performed four days later. At this time a fæcal fistula had formed in the subumbilical incision. The patient was at first very ill; forty-eight hours after operation she was much improved, but her condition soon gave rise to considerable anxiety, chiefly because of the quantity of pus discharged from both wounds.

May 5, 1915: Patient passed a large quantity of pus *per rectum*. From this date to August 5, 1915, condition improved, though the state of the abdominal wounds was never satisfactory. At the latter date severe diarrhœa set in from which she recovered, and her general condition began to improve again, her temperature falling, and her general aspect was much brighter. On August 13, 1915, patient was seized with sudden abdominal pain, a large quantity of pus exuded from the colotomy wound, and she died with all the signs of general peritonitis.

This case has been reported fully on account of its importance. The question arises, Was the pelvic condition due to X-ray treatment? Unfortunately, no post-mortem examination was made and the presence of ulceration of the bowel cannot therefore be excluded. The first symptoms, sharp pain and flatulence after eating, which also caused the bowels to act slightly, commenced six weeks after the last treatment; the bowels were moved in these attacks some ten to twelve times and the condition was always relieved by a small dose of castor-oil. This condition, gradually getting worse, continued till her admission to hospital, but the patient was not seen after January, 1915, till her admission in March, 1915.

The fact that both tubes were inflamed points to the possibility of a recently acquired ascending infection, or it may be that a pre-existing but undetected tubal inflammation was activated by the X-ray treatment. The early symptoms, which commenced six weeks after the last X-ray treatment, pointed, however, to intestinal irritation, and this is the only point in the case which cannot satisfactorily be explained.

THE X-RAY MENOPAUSE.

We have taken the symptom of "flushings" as the best available guide to the severity of the menopausal effects, and inquiry has been made upon this head in every case. The result is that in a little less than 50 per cent. of our cases "flushings" have been reported as "slight" or "absent," or the inquiry has not been answered; in one-eighth they were reported as moderate, and in three-eighths as "severe." In many of the latter class the flushings were frequent both day and night, and persisted in some for two years and upwards after the treatment had ceased. We formed the impression that in some of our cases, a small proportion of the whole, this symptom was more severe and prolonged than we have ever seen it in the natural climacteric.

In all other respects there is nothing that calls for comment in the menopause, except that nervous symptoms of a functional character appeared to be less frequent than under natural conditions. Many of our patients have inquired of us whether as a result of the treatment they would grow fat or lose their feminine qualities of body and mind. Special inquiry has been made of all our patients with regard to the former, with the result that though the majority have gained a certain amount of weight there has been no tendency to corpulence of an unsightly character. With regard to the latter, we have made inquiry when opportunity offered and have not found a single instance in which signs of masculinity appeared or in which there was any loss of sexual feeling; in one case there was a distinct increase of sexual feeling during the treatment, in all others the inquiry was negative.

RELATIVE ADVANTAGES OF X-RAY TREATMENT AND OPERATION.

As X-ray treatment is only suitable for carefully selected cases, we do not think that it will ever supplant hysterectomy as the chief method of dealing with cases of uncontrollable uterine hæmorrhage. Generally speaking, all cases of chronic metritis or fibroid tumours which are complicated by inflammatory disease of the adnexa, all cases of large or degenerating fibroid tumours, and all cases of fibroid polypus must be dealt with by operation. The same must be said of all cases in which malignant disease cannot be satisfactorily excluded. At present it must also be said that only women of 38 years and upwards are suitable for X-ray treatment.

These contra-indications being granted, there still remains a considerable number of cases of uncomplicated chronic metritis and of small fibroid tumours which can be satisfactorily dealt with by X-rays. It is, in our opinion, probable that further experience of the treatment, and perhaps improved technique, will enlarge the scope of the method beyond the limits which we have defined for it. It follows that we have an alternative to hysterectomy in this group of cases, and it is as an alternative procedure only that we have come to regard it.

To many women an operation is an ordeal which is greatly dreaded, while others submit to it with very little reluctance. Most of the cases which we have treated have in fact been so treated on account of the great dread of an operation which these women have manifested. In certain others, special conditions which increase operative risks, such as Graves' disease or valvular disease of the heart, have been present. As a rule, in cases suitable for X-ray treatment, we may allow the patient to decide whether she will be operated upon or whether she will be treated, unless some complication exists which will increase operative risks. Except when organic disease exists elsewhere which renders an operation more than ordinarily risky, if the patient prefers an operation she need not be dissuaded from submitting to it.

As compared with hysterectomy X-ray treatment has the advantages that the ordinary life and work of the patient need not be interrupted for more than two days at a time, and that the prolonged partial invalidism, which often lasts for several months after an abdominal operation, is completely avoided. These are considerations to which we are bound to give weight, and which will in many cases influence the choice of method. The disadvantages of X-ray treatment are the uncertainty as to the length of time required to produce the result aimed at, and the very slight risk there may be that the treatment will be unsuccessful, and that operation may eventually be required. The latter is a minimal risk, and will no doubt be eliminated entirely as experience grows.

CONCLUSIONS.

(1) In our opinion X-ray treatment should be regarded as the method of choice in women over 38 for all uncomplicated cases of severe hæmorrhage due to chronic metritis, or other conditions in which no neoplasm is present. In our experience these cases yield more readily to the treatment than do fibroid tumours. The presence of inflammatory disease of the tubes and ovaries is a contra-indication.

(2) Fibroids of the size not exceeding the height of the umbilicus may be treated with X-rays if the patient is over 38 years old, if the hæmorrhage is of the regular monthly type, and if there is no evidence of inflammatory disease of the tubes and ovaries, or of advanced degenerative changes in the tumour. If intercurrent conditions which tend to increase operative risks are present X-ray treatment should be regarded as the method of choice, in other cases the choice may usually be left to the patient.

(3) No case should be submitted to X-ray treatment without a careful gynæcological examination being previously made, to exclude malignant disease, inflammatory complications, and degenerative changes in fibroids.

(4) The risks of failure with X-ray treatment in suitably selected cases are so small as to be negligible; the X-ray menopause may be attended by more severe flushings than in the normal menopause, but in other respects there is no difference between them; there is no tendency to corpulency or to psychological changes.

SELECTION FROM EPITOME OF CASES.

The following cases, to which reference was made in the foregoing text, have been selected from an epitomized account of seventy-six cases:—

Case 1.—Married, aged 48; children, 0; miscarriage, 0; March, 1918. Symptoms: Severe menorrhagia and dysmenorrhœa. Bad general health; frequent attacks of faintness; these were attributed by Sir James Mackenzie to anæmia resulting from excessive menstrual losses. Local condition: Uterine fibroid size of two-and-a-half months pregnancy.

Treatment: Total exposure, 7 hr. 12 min. in four treatments, from March to June, 1918.

General effects: Patient suffered severely from nausea for several days after each treatment, and on one occasion there was severe diarrhœa. Period April 14 to 25, much less in amount and less painful. Flushings began in May.

Last report, November, 1920; Complete amenorrhœa since April, 1918. Occasional slight brownish discharge for a day or two. Flushings were severe and still continue. Writes that she is "a new woman since the treatment."

Case 8.—Married; aged 52; children, 1; miscarriage, 1; July 9, 1916. Symptoms: Menorrhagia: very severe floodings following first confinement twenty-eight years ago; severe dysmenorrhœa. Diagnosis: Chronic metritis. Uterus nearly twice its normal size.

Treatment: total exposure, 3 hr. 15 min. in four treatments. July to October, 1918.

Effect on menstruation: Amenorrhœa for six weeks after first treatment. After this menses every two to three weeks, with very severe floodings, for which patient had to be plugged.

Hysterectomy was advised and performed November 6, 1918. At the operation no adhesions were found; uterus was twice its normal size, the condition present being one of chronic metritis with great thickening of endometrium. Patient has continued well to the present date—January, 1921.

Case 12.—Married; aged 37; children, 1; August 21, 1916. Symptoms: Menorrhagia; very severe backache. Patient suffers from gastric ulcer. Diagnosis: Fibromyoma, extending up to 2 in. below the umbilicus.

Treatment: Total exposures, 3 hrs. 29 min. Last treatment December 2, 1915. The treatment carried out by irradiating three to four areas every three weeks instead of ten to twelve as was usually done, which probably explains the failure to produce permanent amenorrhœa. The patient refused to have further X-ray treatment and requested that the uterus should be removed.

Effect on menstruation: Amenorrhœa, December, 1915, to June 24, 1916, when a normal period occurred. Then missed for three months, when period came on and recurred every fourteen or twenty-one days, with occasional floodings, to time of operation—March, 1917. Severe backache unrelieved by the treatment. Local effect: Tumour gradually diminshed in size till August 3, 1916, when a subperitoneal fibroid the size of a hen's egg extending out from the right side of the uterus was all that could be found. General effects: General health improved. Flushings fairly severe still—January 8, 1921.

Operation (April, 1917): Supravaginal hysterectomy was performed; the uterus contained a fibroid, the size of which is not mentioned in the notes. There were dense adhesions between the uterus and the rectum, and some adhesions of small bowel to the uterus also. The left ovary was cystic. The right small and fibrotic. The left tube and ovary were removed with the uterus. Patient reports herself very well at the present time (January, 1921). No intestinal symptoms reported either before or since operation. The backache, however, remains severe. We consider that failure in this case was due to insufficient treatment.

Case 23.—Married; aged 50; children, 4; miscarriage, 1; June, 1914. Symptoms: Severe menorrhagia for five years, 10/25. Suffered much from "heart trouble," and this was attributed by Sir James Mackenzie to the profuse monthly losses. Local conditions: Irregular fibroid tumour size of about four months gravid uterus.

Treatment: Total exposure 6 hr. 54 min. in four treatments.

General effects: Complete amenorrhœa after third treatment; first two treatments produced no diminution of bleeding. Severe flushings which lasted for about two years. Local effects: Complete disappearance of the fibroid was noted on March 17, 1915, the uterus being approximately normal in size and outline.

Last report, January, 1921: No return of periods. General health excellent, and she leads a very active life. The uterus is now about the size of the normal nulliparous organ, and no trace of fibroid tumour can be found.

Case 29.—Married; aged 42; children, 5; January 8, 1917. Symptoms: Severe menorrhagia, 10/24, bleeding being at times alarming in severity. Local conditions: Large nodular multiple fibroid tumour extending nearly to umbilicus in mid-line. Patient corpulent.

Treatment: Total exposure, 21 hr. 30 min. in eleven treatments over a period of fourteen months.

General effects: The treatment completely failed to arrest bleeding; an interval of five months occurred at one time during treatment, but this was succeeded by irregular hæmorrhage which was still continuing, though in less quantity, in December, 1920. The patient persistently refused operation.

Case 31.—Married; aged 46; children, 2; October 2, 1917. Symptoms: Severe menorrhagia, 7-10/21. Local conditions: Smooth hard fibroid extending to lower border of umbilicus and with little mobility.

Treatment: Total exposure 8 hr. 7 min. in six treatments, October, 1917, to April, 1918.

General effects: No serious loss after second treatment; nearly constant slight show of blood from March to June, 1918; no loss at all after then; flushings moderate. Local effects (June 12, 1918): No tumour palpable on abdominal examination. On vaginal examination uterus found anteverted, bulky, freely mobile, with an ill-defined small outgrowth on left. Slight X-ray dermatitis.

Last report (November, 1920): No return of periods since June, 1918. Slight flushings still occur occasionally. General health better than for years and very active.

Case 38.—Married,; aged 45; children, 1; October 17, 1914. Symptoms: Moderate and irregular menorrhagia. Local conditions: Hard nodular fibroid tumour extending to level of upper border of umbilicus. She had refused to undergo hysterectomy before consulting us.

Treatment: Total exposure 12 hr. 36 min. in eight treatments from October, 1914, to June, 1915.

General effects: Very little until after fourth treatment, then three months' amenorrhœa followed by a severe period in April, 1915. Another period in May, then complete amenorrhœa. No flushings during treatments. Local effects January 17, 1916: Upper border of tumour is felt at level of pubes; on bimanual manipulation tumour reduced to less than half its size when first seen. May 19, 1919, uterus found retroverted; approximately normal size, with several small subperitoneal nodules on surface.

Last report, November, 1920: Flushings have occurred slightly during last six months (age 51). General health very good. Leads an active life. Has lost a little weight.

Case 39.—Married; aged 45; children, 0; miscarriage, 0; May, 1916. Symptoms: Fairly severe menorrhagia. Local conditions: Hard nodular fibroid tumour extending nearly to umbilicus.

Treatment: Total exposure 15 hr. 50 min., in eight treatments over two years, June, 1916, to May, 1918.

General effects: After three treatments a two months' interval occurred, followed by a show for two to three days, and then complete amenorrhœa for six months. Since September, 1917, one or two moderate periods each year. Flushings slight. Local effects: In April, 1918, the fibroid had diminished to two-thirds of its original size; no further shrinkage occurred.

Last report, November, 1920: Good general health and leads an active life. One or two moderate "periods" still occur every year.

Case 41.—Single; aged 38; July 25, 1914. Symptoms: Menorrhagia. Diagnosis: Fibroid size of two months gravid uterus.

Treatment: Total exposure, 1 hr. 57 min. in two treatments. Last treatment September 19, 1914.

Effect on menstruation: Menorrhagia continues and there is also slight daily loss, September 19, 1914. Ceased to attend; Treatment incomplete.

Report, 1920: No reply.

Case 49.—Married; aged 38; children, 1. Symptoms: Menorrhagia, headaches, debility. Diagnosis: Chronic metritis.

Treatment: Total exposure 2 hr. 10 min. in two treatments. Last treatment June 24, 1918.

Effect: After two treatments period diminished to normal. General health improved. Decided to give no more treatment.

Note taken April 1, 1920: Amenorrhœa, July, 1918, to January, 1919. January, 1919, to July, 1919, periods every fourteen to twenty-one days, duration ten days. Amenorrhœa July, 1919, to January, 1920. January, 1920, period lasting fourteen days. Amenorrhœa since to April 1, 1920. Patient refused further treatment.

Case 56.—Married; aged 47; children, 0; May 4, 1917. Symptoms: Menorrhagia; very marked neurasthenic symptoms. Diagnosis: Chronic metritis.

Treatment: Total exposures 3 hr. 40 min. in three treatments from May to August, 1917.

Effect on menstruation: Amenorrhœa from September, 1917, to September, 1919, when she had hæmorrhage for two to three weeks. Advised further treatment but this was refused. Amenorrhœa from September, 1919, to June, 1920, when severe hæmorrhage occurred, lasting two days. Again severe hæmorrhage September, 1920. Patient had been taking thyroid extract. Advised further treatment or curettage, but this was refused. General effects: Flushings moderately severe.

Last report: September 25, 1920.

Case 65.—Married; aged 43; children, 2; October 16, 1918. Symptoms: Very severe menorrhagia necessitating three to four days in bed. Local conditions: Bulky uterus but no fibroids, probably chronic metritis.

Treatment: Total exposure 8 hr. 40 min. in five treatments from October, 1918, to February, 1919.

General effects: After the first and second treatments considerable improvement, an interval of seven weeks having occurred. After third treatment a very bad hæmorrhage occurred which lasted altogether for a month. Slight flushings.

Last report, January, 1921: Menstruation still occurs at irregular intervals, but loss is moderate since treatment. Flushings only slight.

Case 70.—Married; aged 40; children, 2; miscarriage, 0; August 6, 1915. Symptoms: Menorrhagia two and half years. Severe leucorrhœa. Diagnosis: Retroversion of uterus. Chronic metritis.

Treatment: Total exposure 4 hr. 40 min. in five treatments, August to December, 1915.

Effects on menstruation: Amenorrhœa from November, 1915, to March, 1916. Regular normal menstruation ever since.

Report, 1920: Periods have been regular, four to five days, loss slight since March, 1916. General health much improved. Gained weight.

Case 75.—Married; aged 43; children, 3; August, 1919. Symptoms: Prolonged and very severe hæmorrhages lasting from two to four weeks, with irregular intervals. Profound anæmia and debility. Local conditions: Bulky uterus, no fibroid. Chronic metritis. Patient was advised to undergo hysterectomy, but she and her husband (a doctor) both declined.

Treatment: One treatment lasting 1 hr. 50 min. was given, and this was followed by a flooding so severe that consent was given to operation. The uterus was successfully removed, and the diagnosis of chronic metritis confirmed.

January, 1921, the patient is now in very good health.

Case 76.—Single; aged 46; February 14, 1914. Symptoms: Menorrhagia for three years, pain for a week before periods. Local conditions: Hard fibroid extending to upper border of umbilicus.

Treatment: Total exposure, 9 h. 56 min. in six treatments.

Effects: Relief of pain. Amenorrhœa from May to November, 1914. Severe flushings. Severe losses in February, March and April, 1915. Local effects: No change in fibroid. Hysterectomy, April 30, 1915. No adhesions.

DISCUSSION.

Dr. N. S. Finzi said that the principle of the treatment was that the same dose of X-rays had a different effect on the ovaries and the fibroid tumour from that which it had on the surrounding structures. Consequently by a suitable technique they were enabled to bring about the menopause without damage to tissues other than the ovaries and the fibroid. That there was a direct effect on the fibroid itself was proved by the cases treated after the menopause in which involution of the tumour had occurred. In order to get a sufficient dose of X-rays to the ovaries and uterus, certain special precautions must be used. The structures to be treated were situated at a distance of 3 or 4 in. or more from the surface. Now they were limited in the amount of radiation they could give by the amount the skin would tolerate. When this dose had been given to the skin the deep parts would have received less (1) because the rays from the tube fell off inversely as the square of the distance and (2) because the intervening tissues absorbed a proportion of the rays. The effects of (1) were diminished by placing the tube at a greater distance from the skin and the effects of (2) were diminished by filtering the rays through metal, preferably aluminium. There were two main schools of technique. The school adopting the Freiburg method relied on many small ports of entry, the rays crossing inside the patient and the tube being near to the patient's skin. The advocates of the other method utilized only three or four ports of entry, placed the tube at a distance from the skin, but the radiation from the different areas still crossed in the patient's body. The former method took considerably longer time than the latter and as far as he could see presented no advantages. He had recently heard from people in Germany that the Freiburg school had now abandoned their technique in favour of a simpler one with fewer ports of entry. Working with intensive modern methods the total exposure time by the second method could be brought down to fifteen minutes or less per series of treatments while the Freiburg method took two to four hours. He differed from the authors with regard to the time of the application relative to the period. He preferred to make the application in the week preceding the period when the parts were engorged with blood and at their maximum of sensitiveness to the radiations. In order to prevent radiation sickness, which occurred in a large proportion of cases if the application were given on one day, he spread this out over a week and so in the majority of cases completely avoided this trouble. The next series of treatments commenced four weeks after the beginning of the first series and so on. It was necessary to give at least three series, sometimes four and occasionally even five or six, especially with big fibroids: usually three were enough. The question of radium treatment had to be considered in relation to X-rays. Its advantages were (1) that usually one application was sufficient, though occasionally two might be necessary; (2) that it acted much more quickly than X-rays and that the number of cases in which the subsequent period was excessive, was very small; (3) that its action was more local and that the tissues around the uterus received but little irradiation. The disadvantage of radium treatment was that an anæsthetic was almost always necessary for the introduction of the radium which must be into the uterine cavity, though the radium had been introduced after dilatation of the cervix with tents. In the case of large fibroids he preferred X-rays, in the case of small fibroids or metritis either might be used and in cases of great anæmia radium should be used. Recently he had had to use radium in a case of mental disturbance apparently due to menorrhagia with great anæmia.

Disadvantages of X-Ray Treatment.—Radiation sickness could be prevented as he had indicated. The effects on the skin were the production of pigmentation and epilation, which persisted for some time and might be followed by telangiectases. This however was not usual with the doses required in this condition. Cases had been described of late X-ray effects, due as he had pointed out elsewhere to an infection in tissues that had been damaged by X-rays. He did not find that he had carried the treatment far enough in these conditions to render the skin liable to this complication, though in the treatment of malignant disease it was a possibility that must be faced. With the four or five series of treatments the skin did not usually show a permanent alteration, still less with three series. He was told by gynæcologists that they found very dense adhesions around the uterus and ovaries when subsequently they had to operate on these cases so that where a subsequent operation was likely to be required the treatment would appear to be contra-indicated.

Contra-indications.—The somewhat arbitrary age limit of 38 was usually fixed as the youngest at which a patient should have X-ray treatment and Dr. Williamson would no doubt tell them of cases he had seen treated younger than this with certain bad results. Dr. Finzi's own cases had always been over this age. Any form of degeneration of the fibroids and any inflammatory charge in or around the uterus or ovaries were contra-indications and he suggested that in some of the cases, such as in the case mentioned by Dr. Eden in which pelvic inflammation had subsequently occurred, there was dormant trouble in the tubes which had been stirred up by the X-ray treatment. Malignant disease must be carefully excluded, for although this might possibly be curable by X-rays, much larger doses and longer applications would be needed than for fibroids. Pregnancy was of course a contra-indication. In extreme anæmia—though X-rays should be avoided, in view of the possibility of the subsequent period being even more excessive, this did not apply to radium. Even after transfusion these cases were not usually very suitable for operation, but the radium treatment afforded an easy method of relieving them. He did not believe that the size of the tumour was any contra-indication to X-ray treatment. He had treated tumours which reached up to the ensiform cartilage with complete success and with a suitable X-ray technique he could not see any objection to treating these with X-rays. The tumour continued to diminish long after the cessation of the treatment. Whether to employ X-rays or surgery in a case suitable for either was a different matter. At any rate X-rays had the advantage that the patient was able to continue her work and was not exposed to the strain of a big operation with its subsequent prolonged convalescence, which might occasionally last six months or more before the patient was quite fit again. The mortality of modern hysterectomy was very small but even then was greater than the mortality from X-ray treatment. In many of these cases the patient should be given her choice of the treatment after putting the matter fairly before her. In any case a thorough examination by a skilled gynæcologist was essential.

He had treated about 100 cases extending over nine years and so far had had one complete failure and there was another case in which a certain amount of loss had recommenced after six months though it was not excessive; this case was still under observation. He had however only treated the most favourable cases and almost all the patients were over 40.

Dr. BLACKER was very interested to find that Dr. Eden was using X-rays so extensively for fibroid tumours, a method of treatment which he himself had abandoned in 1916 in favour of the use of radium. The number of cases of fibroid tumours suitable for either of these modes of treatment was very small. No complicated fibroid should be so treated, no very large fibroid, no submucous tumour, no degenerating tumours, and no tumours associated with any signs of pelvic peritonitis, or giving rise to pressure symptoms. When all these were eliminated, the number left suitable for treatment by radium was very limited. In cases of excessive hæmorrhage at the menopause, radium however was practically a specific. He had treated now over forty cases; the majority of these were cases of so-called chronic metritis or fibrosis of the uterus with marked menorrhagia, while some ten or twelve were small fibroid tumours. Radium could be introduced into the cavity of the uterus, and its use in this way could be combined with an application made through the abdominal walls. It seemed to him to have many advantages; it acted chiefly on the uterus, producing an obliterative endarteritis of the vessels, and exerted much less effect upon the ovaries than X-rays; the treatment lasted a shorter time, only some two hours, it required no special or complicated apparatus, the risk of skin burns was eliminated unless an external application was made, and the intra-uterine introduction of the tube necessitated dilatation of the cervix, and supplied an opportunity for the performance of an exploratory curettage which he considered absolutely essential to exclude the possibility of malignant disease being present with certainty in every case in which either X-rays or radium were used. It was for this latter reason especially that he preferred radium to X-rays. The technique was very simple; under anæsthesia the cervical canal was dilated to the size of a No. 12 Hegar's dilator, an exploratory curettage was carried out, and the radium or radium emanation in a lead tube 2 mm. thick, protected with 3 mm. of rubber, was introduced into the uterine cavity, the cervix being plugged with ribbon gauze and the tube left *in situ* for the necessary length of time, usually twenty-four hours. This represented a dose, when 100 mgr. of radium was used, of some 2,400 mgr. hours. A larger dose than this was seldom necessary, and smaller doses should be used in young women. He had employed radium for intractable menorrhagia in three women, 29, 31, and 34 years of age respectively, and in one of these cases he had given a second dose. In one of his patients with a fibroid tumour, the uterus sound passing 5½ in. after a period of amenorrhœa lasting nine months, the hæmorrhage had returned, and he had recently given another dose of 4,800 mgr. hours; this was the largest dose he had so far employed. His experience was that in a number of the cases in which radium was employed the next period was excessive, and this was often followed by permanent amenorrhœa, or a second slighter period sometimes intervened. After the use of large doses a blood-stained, sometimes somewhat offensive discharge persisted for some weeks and even for several months. He thought the menopause was usually not severe, no doubt owing to the action of the radium being mainly on the uterus and not on the ovaries. The recorded cases showed that in cases of fibroid tumours shrinkage of the growth constantly followed the occurrence of amenorrhœa. The results were more certain in the cases of hæmorrhage at the menopause than in those of fibroid tumours, but in 184 cases of fibromyomata of the uterus recorded by Howard Kelly,[1] 171 were cured by the use of radium. In his own cases he had had three recurrences: one in a patient, aged 52, already alluded to, and two in young women in whom it was not attempted to set up the menopause but only to check excessive hæmorrhage. In one of these patients the periods were now not excessive but normal, in the other they recurred excessively, and another dose had been given. If a second dose were given it was best to give it within some three months of the first. Out of 600 cases recorded by Stacey[1] treated by radium at the Mayo clinic, sixty-nine of whom were under 35 years of age, pregnancy had followed in nine cases. Of these women three had full time healthy children, one had a full time dead child, two had premature dead children, one had had two miscarriages, and two were probably pregnant at the time the paper was written. It had been suggested that pregnancy following the use of X-rays or radium might result in the birth of a monster, but so far as he knew there was no evidence to support that view. Further investigations were needed to determine the proper place of radium in the treatment of fibroid tumours of the uterus, and as a means of controlling severe menorrhagia, especially in young women, and the end results of these cases had yet to be recorded. He had recently had a case of fibroid tumour treated by X-rays, with a cure of the symptoms and shrinkage of the tumour, in which nine years afterwards the patient had developed an ulcer in the abdominal wall, the result of an X-ray burn, which refused to heal and necessitated excision. The important question as to whether patients treated by radium or X-rays were more prone to develop malignant disease in later life had yet to be settled. At present, however, he would continue to use radium for a limited number of fibroid tumours, and thought it better in every way than the employment of X-rays for this purpose.

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[1] *Surg., Gyn., and Obstet.*, 1918, xxvii, pp. 402-409.

Dr. L. MARTINDALE said that since January, 1914, she had had 136 cases under her care: out of these she had performed hysterectomy in fifty-six cases; myomectomy in five cases; she had used X-ray therapy in forty-three cases. In five cases hysterectomy had been performed after X-ray treatment. In 41 per cent. of cases therefore of uterine fibroids she had definitely chosen radiotherapy, although when she had come to analyse those cases in which she had performed hysterectomy, she found that no fewer than nine out of the fifty-six would have been just as satisfactorily treated by X-rays, making therefore the probable percentage in which radiotherapy could have been satisfactorily employed as 50 per cent. The *technique* she had adopted was the one she studied in 1912 and 1913 in the Gynæcological Clinic of Freiburg University under Krönig and Gauss, with slight modifications due chiefly to the use of a Coolidge tube since 1919. She would omit the details of the technique as she had already published these as well as a careful analysis of the cases treated, but briefly speaking she used much cross fire through eighteen to twenty-two ports of entry, carefully marked out on the patient's abdomen and sacrum. The tube was tilted so that the central ray through each square area reached the ovaries. She gave one series of two treatments on two consecutive days, once in three weeks. She worked with a very hard tube, at least 9 in. spark gap, and with 4 to 5 ma., and used a filter of 3 mm. aluminium. The protection of the patient was extremely thorough, and the dosage was measured by Kienböck's strips which her nurse carefully developed at a specified temperature in a standard developer for a specified time. She had therefore accurate and permanent records of the dosage employed for each patient. She had never seen any bad effects, never of course a burn, and only twice any pigmentation. In five cases there was some "Röntgen-jammer."

With regard to *choice of treatment*, the ideal cases for X-ray treatment she had found to be those in which the patient's age was between 40 and 50, the tumour not bigger than a six months' pregnancy and the fibroid interstitial, the chief symptom being menorrhagia. In such cases one could predict that from four to six treatments would effect a cure, that was to say, a lasting amenorrhœa, an improvement in the general condition of the patient, and a shrinkage of the tumour to at least half its original size, and with this a climacteric free from all uncomfortable symptoms.

Again, cases complicated by grave heart or lung disease, exophthalmic goitre, asthma, or any other serious disease, did well with X-ray therapy, and indeed in such cases she had X-rayed successfully even when the tumour reached far above the umbilicus. She had however definitely chosen operative treatment.

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[1] *Amer. Journ. Roentgenology*, 1920, vii, p. 379.

(1) In cases of submucous, subperitoneal and pedunculated fibroids.

(2) In all cases in which metrorrhagia had led her to suspect carcinoma of the body.

(In some cases she had done a diagnostic curetting before deciding on which treatment to adopt.)

In all cases of doubtful diagnosis she had more than once mistaken a dermoid cyst of ovary with some old adhesions—for a fibroid, and in one case she remembered curing the menorrhagia only to find three years after, that what she had taken for a soft fibroid was in reality an ovarian tumour which of course had accounted for the fact that there had been no shrinkage of the tumour!

In analysing her X-ray cases she found as regarded

(1) *Age Incidence*, that her youngest patient was 35, and the eldest 58, the average age being 47.

(2) *Occupation.*—Twenty-six were married, eighteen having had children; seventeen were unmarried; eleven were head mistresses or matrons, one an author, one a Government official, and five were in business and so on.

(3) *Number of X-ray Treatments.*—The average number given was seven; the average number before amenorrhœa had been produced was four. In four of her cases a fresh series had had to be given after an interval of some months; in one case, after ten months' amenorrhœa there had been a monthly period; in another after seven months. In another there had been slight metrorrhagia. In fact both she and another gynæcologist had tried to persuade the patient to have hysterectomy. She had refused but had allowed her to do a diagnostic curetting which proved negative. She had given her some more X-ray treatment, and it was now three years since the patient had had any metrorrhagia or other symptom. She was in fact perfectly well.

(4) *Hysterectomy after X-ray Treatment.*—In five cases, a hysterectomy had been performed after X-ray treatment, one by another surgeon: therefore she had taken the opportunity of having sections cut of the uterus and ovaries.

(*a*) In one case, after nine treatments (2216 X), there had been symptoms of abdominal pain. So in an interval she had performed appendicectomy and hysterectomy. The pathologist's report was: "Sections show a very cellular fibroid; there is no sign of inflammatory change and degenerative changes are also absent."

(*b*) In another case, after seven treatments (2390 X), the report was: "The large fibroid had been cut, and shows the usual muscle bundles in a fibrous stroma. There is no obvious increase in the amount of fibrous tissue, or other degenerative change. The ovary also shows all the usual structures including a recent corpus luteum, so that in this case the X-rays have not apparently destroyed the ovarian function. No evidence of any malignant growth."

(*c*) In another case, X-rays had cured the menorrhagia, the patient having had four treatments (1250 X). She had remained very well for a year, and then there was gastro-intestinal trouble, for which she was under a London physician. In November, 1917, when Dr. Martindale saw her, she was emaciated, having lost 1½ st. in weight. She had some mucous colitis. On examination Dr. Martindale found she had ascites and symptoms of chronic intestinal obstruction. The uterus was very hard and immovable. A London surgeon saw the patient with her and decided to operate. A total hysterectomy was performed; the fibroid had undergone calcification in some areas. The intestines were covered by small white spots. The patient died ten days after. The post-mortem showed "dense matting of all intestines and masses of malignant growth, of omentum, stomach and mesentery; there were numerous hard lumps like sago grains. Sections showed a malignant growth, probably endotheliomatous in origin and apparently primary in omentum." A similar case had occurred in her practice last year, although no drugs had been used.

(*d*) In another case the patient had complained of metrorrhagia. She therefore did a diagnostic curetting, and as there was no malignancy, and as she could not prevail upon the patient to let her do a hysterectomy, she therefore gave her seven treatments (2045 X). Amenorrhœa began after the fifth treatment, but as the pressure symptoms continued (incontinence of urine being the most troublesome) she at last prevailed upon the patient to let her do a subtotal hysterectomy. This she did on June 14, 1917, removing the left tube and ovary as well. The fibroid uterus weighed 5½ lb. and the larger of the two subperitoneal tumours showed degeneration. The sections showed simple fibroid growth, no malignancy. She was now in excellent health.

(5) *Results of X-ray Treatment.*—With regard to results of X-ray treatment, she had found that in all the other cases of her series, the patients had done extremely well. They all told her they were improving in health as the weeks went by. Probably this was primarily due to the cure of the anæmia, but some other factor must have been at work as well. She had recently written to or seen all her cases except two, and they were all telling her how well and energetic they felt, so much so that on the whole she was of opinion that a woman who had undergone X-ray treatment aged less quickly than a woman who had undergone a hysterectomy. If so, suitable patients should be given the opportunity of choosing to undergo X-ray treatment rather than hysterectomy, and therefore, if possible, X-ray rooms should be attached to every gynæcological clinic.

Dr. HERBERT WILLIAMSON said that he believed in the value of X-rays and radio-active substances, not only in the treatment of uterine fibroids and allied conditions, but also in malignant disease. He foresaw a time—at no very distant date—when the knife would be laid aside and its place taken by X-ray and radium therapy. The treatment was still empirical; they were now collecting facts from which general laws would ultimately be deduced and a science built up. The essence of science was measurement, but unfortunately exact measurement was at present impracticable, because of the lack of homogeneity of the rays used and because of their inability to calculate the amount of radiation lost in the passage of the rays through the tissues which intervened between the skin and the tumour in any given patient. He regretted however that Dr. Eden and Mr. Provis had merely recorded time exposures, which told nothing as to the dose employed. Had they used either the X or the H unit, or the Sabouraud dose, their records would have been of greater value for clinical purposes.

In general, his experience had been very similar to that of the authors of the paper. Between August, 1919, and December, 1920, eighteen cases of fibromyomata and chronic metritis, in his wards at St. Bartholomew's Hospital had been treated by his colleague, Dr. Finzi. The cases had been carefully selected after consultation between them; all the chronic metritis cases had been curetted and the curettings microscopically examined before treatment was undertaken. The cross-fire method had been adopted; three or four large ports of entry had been employed, and the dose used at each application was 7 or 8 H. Treatment had been given on two successive days and usually four to six such series were necessary to produce amenorrhœa. There had been no untoward results in this series, and the results had been successful in approximately 80 per cent. of the cases.

In selecting cases it must be remembered that the operation of hysterectomy for fibroids was one of the most satisfactory in the whole range of surgery and possessed the advantage of the patient's ovaries being left intact. These two considerations must influence them in choosing the treatment for any given case and he recognized ten groups in which X-rays should not be employed:—

(1) Where the patient was under 40 years of age.

(2) Where the tumour could be enucleated by either vaginal or abdominal operation.

(3) Where changes of degeneration were present.

(4) Where the tumour was very large.

(5) Where there was evidence of old or recent inflammation of the ovaries and tubes.

(6) Where there was suspicion of malignancy.

(7) Where there were severe pressure symptoms.

(8) Where complicated by an ovarian cyst.

(9) Where complicated by pregnancy.

(10) Where the patient was gravely anæmic with a red blood count of less than 2½ million and hæmoglobin below 35 per cent.

He had seen disastrous results follow the treatment in unsuitable cases—severe kraurosis vulvæ in young women; lighting up of dormant infections in the Fallopian tubes; acute inflammation with peritonitis in degenerating fibroids; and severe and intractable hæmorrhage. To this list must be added a case in which columnar-celled carcinoma of the body of the uterus had developed a year after the successful treatment of fibroids. He had three times performed hysterectomy in cases previously treated by X-rays, and here his experience differed from that of the authors of the paper, for he had found dense adhesions in one case of cartilaginous hardness.

As to the action of the rays he believed it was exerted mainly upon the ovaries and that the amenorrhœa was produced by the destruction of the follicles and interstitial cells; but he admitted that changes were also produced in the tumour, for histological examination had revealed a necrosis of endothelium, a thrombosis in the smaller vessels and sometimes a replacement of muscle by fibrous tissue. He had never heard a satisfactory explanation of the mechanism by which the rapid shrinkage of the tumour was brought about.

Dr. S. GILBERT SCOTT said that it was now some eighteen years since the first attempts had been made to apply X-rays as a means of inducing an artificial menopause and for relieving symptoms where fibrous and myomatous tumours of the uterus were present. He said that English radiologists were sceptical when this method of treatment was advocated by Continental workers, but practical experience soon showed them that they had a very valuable agent at hand, and remarkable results had been achieved, even in those days, when their apparatus and technique were still undeveloped. Gynæcologists had been as sceptical as radiologists, and, owing either to conservatism or prejudice,. little headway had been made in this country until recently. The Section of Obstetrics and Gynæcology appeared to be taking up the matter seriously, and the Conjoint Discussion of radiologists and gynæcologists that had taken place last year at the Cambridge meeting of the British Medical Association showed the keen interest that was now being shown in it.

It was only from large numbers of cases that any definite rules could be laid down as to which cases were suitable and which were unsuitable for X-ray treatment. The following conditions should be observed if results were to be satisfactory:—

(1) Whoever carried out the treatment, whether gynæcologist or radiologist, must have absolute control over his technique, dosage, &c. Slipshod methods were not permissible. He must possess a sufficiently powerful apparatus and must be familiar with its use.

(2) The gynæcologist's opinion as to the condition was essential before the radiologist could decide whether the case was suitable or not. The ideal method was for the gynæcologist and radiologist to work conjointly, seeing the patient together in consultation, as he believed was now done at St. Bartholomew's Hospital.

If these two conditions were neglected, the results would be unsatisfactory and the treatment dangerous.

He would not repeat his observations made at Cambridge, but he did emphasize the control one had over the common menstrual disturbances, such as dysmenorrhœa. The age of the patient did not matter, as there was no need or risk of sterilization; and it was easy to coax the periods back to normal in most cases without the necessity of stopping even one. It was quite a mistake to think that to obtain results in these cases, sterilization, whether temporary or permanent, was necessary. The technique was somewhat different to that used in fibroids, but that he would not now discuss.

Dr. CUTHBERT LOCKYER said that the conclusions arrived at by the authors formed a judicial summary of their work in the treatment of uterine hæmorrhages by X-rays which should prove of great value to every gynæcologist. One effect of this contribution to the subject should be to dispel any doubt which might still exist as to the value of radiotherapy in the treatment of uterine hæmorrhage. Scepticism as to the helpfulness of X-rays in gynæcological practice might have largely been due to the extravagant claims made by Continental authorities who claimed (at Halle in 1913) 100 per cent. of "cures" by the indiscriminate use of the rays employed, that was to say, without distinction of the patient's age, the size of the tumour, or the amount of blood lost. He welcomed the conclusions arrived at by the authors as a timely antidote to such extravagance, and was in complete agreement with them as regards the limitations in the application of X-rays which they have laid down. It would be interesting to hear from the authors how these limitations worked out in practice—

i.e., what percentage of the total cases seen were deemed suitable for X-rays. Dr. Louisa Martindale stated at Cambridge last July that in a series of 118 cases of fibroids twenty-five were left untreated, fifty-one were submitted to operation. For thirty-seven intensive X-ray therapy was employed, and in five others X-ray therapy was followed by hysterectomy. This meant that 39·7 per cent. of cases were deemed suitable for X-rays. It was possible that Dr. Eden and Mr. Provis had worked within narrower limits, since in their treatment of fibroids they limited the size of the tumours to the umbilical level. In reference to dosage, he was disappointed that the authors, whilst using the Kienböck strips, declined to state the amount of rays used in X units, so as to bring the expression of their dosage into line with that of other observers. Dr. Martindale told them that in her series of fifty-one cases the average dose was 2971 X, and naturally one would like to know how this compared with the dosage of total-time exposures mentioned by the authors. From the discussion at Cambridge it was clearly shown that radiologists themselves differed in opinion as to the relative accuracy or inaccuracy of the photographic tests of dosage. In spite of this it would seem that the same test used by all would give figures of distinct helpfulness. One case of outstanding interest was that of a woman aged 40, whose condition was diagnosed as chronic metritis with impaired mobility of the uterus. Six weeks after the conclusion of her treatment intestinal irritability became apparent, and continued until operation some six and a half months later. It was found that both tubes were inflamed, and one was purulent. A pocket of pus was found in adhesions between uterus and rectum. The authors suggested that an ascending infection occurred after the conclusion of the radiotherapy, for which, of course, the period of eight months' would allow sufficient time. There seemed to be two other alternatives: (1) That the X-rays caused ulceration of the rectum; (2) that the "impaired mobility of the uterus" was evidence of pelvic inflammation existing when first seen, and which contra-indicated the use of X-rays altogether.

Dr. AGNES SAVILL said that it was her custom when treating fibroids by X-ray, to divide the abdomen into six areas, two central and two lateral, and give one filtered pastille dose on each area on two successive days, immediately after the period, for three months. A fourth time was sometimes required. X-ray sickness could only be avoided by giving a small number of exposures, and in future she intended to try the method which was so successful with Béclère in Paris—the abdomen divided into two large areas with a diameter of about 4 in., one filtered pastille dose being given on each area each week for eight weeks. She did not care to administer X-ray for protracted hæmorrhage in women under 40. For these, uterine ionization with copper was preferable, administered according to the method introduced by the late Dr. Sloan of Glasgow. Recently she had had a girl aged 23, who had been curetted twice and cauterized once on account of protracted periods lasting for several months. After each operation there had been amenorrhœa for several months, but when the periods recommenced, the hæmorrhage had been as profuse as before. She was brought to Dr. Savill as a last resort before a specialist decided to perform hysterectomy. After ten applications administered two and three times a week, she was cured. Dr. Savill saw her fifteen months later when the patient told her she had had normal periods ever since. Another patient, aged 34, was similarly cured of twelve years' profuse periods lasting two weeks each month.

Dr. EDEN (in reply) said that he considered it a very important point that practically all the speakers were in general agreement with the authors as to the kind of case which was suitable for X-ray treatment. There was this important difference between treatment by radium as advocated by Dr. Blacker and treatment by X-rays, viz., that the former was an operative method while the latter was non-operative. In using radium for intra-uterine application it was necessary to dilate the cervix under general anæsthesia, and Dr. Blacker also advocated diagnostic curetting to exclude malignant disease. This procedure might have to be repeated a second or third time, and it seemed to him that if all this operative interference had to be practised one might as well remove the uterus at once and make an end of it. X-ray treatment avoided operative measures altogether, and therein it was to be preferred to radium in the case of women who dreaded the operative ordeal very much. He was quite unconvinced by the arguments made in the discussion that X-ray treatment caused pelvic adhesions to form of a particularly dense character, which made subsequent operation, if that should prove necessary, more formidable. The fact was that adhesions equally dense and troublesome had been met with frequently in cases which had never been near an X-ray tube, and the matter would have to be gone into much more carefully before it could be regarded as settled. X-ray treatment was still in the experimental stage, and a good deal of information was still required with regard to the remote effects, and the action of the rays on normal tissues.

Mr. Provis (in reply) said that he did not think that radium was a safer agent to use than X-rays or that it was easier to control an X-ray tube than it was to control a tube of radium. He thought by having numerous ports of entry for the rays one safeguarded the skin more adequately, for each port of entry was only irradiated for ten minutes at a time. The question of dosage he agreed was unsatisfactory, but that until some more certain method of measuring the dose had been discovered it was better to adopt the time exposure as a measure of the dose given. He did not think that the X-ray in its present experimental stage should be used in the treatment of menorrhagia or dysmenorrhœa in young women.

Section of Obstetrics and Gynæcology.

President—Mr. HENRY BRIGGS, F.R.C.S.

Two Cases of Sarcoma of the Uterus with Specimens and Microscopical Sections.[1]

By H. RUSSELL ANDREWS, M.D.

(ABSTRACT.)

(1) A SINGLE lady, aged 65, had been examined twelve years previously by a competent observer and told that she had a uterine fibroid, which was causing no trouble. Six years ago the tumour was the size of an orange and could not be felt on abdominal examination. After symptoms and signs indicative of rapid growth and malignancy, extending over a period of about three months, I removed a large sarcomatous tumour from the uterus, which, although it appeared to be very malignant, was almost entirely enclosed in a capsule. The uterus contained no other tumour. There seemed to be no doubt that a uterine fibroid had become sarcomatous.

(2) In the second case, a necrotic sarcoma of the uterus, a large amount of a jelly-like discharge passed into the peritoneal cavity through a hole in the posterior surface of the uterus.[2]

DISCUSSION.

Dr. HERBERT SPENCER showed a specimen from a patient aged 65; he said it was clearly a sarcoma developing in a submucous myoma. He had published two similar cases in the *Proceedings* of the Society. It was this tendency to sarcoma that led him to abandon amputation of the uterus for myoma in favour of total hysterectomy. Sarcoma of the uterus, though rare, was undoubtedly commoner than some gynæcologists thought; he had found it in 6 per cent. of cases of myoma, and Bumm put the figure as high as 12 per cent.

Dr. HERBERT WILLIAMSON said that the specimens demonstrated that fibromyomata could undergo a malignant change years after the menopause; and that the doctrine that these tumours were unlikely to be dangerous after that time was fallacious. In a case shown by himself and Dr. Griffith in 1906, there was evidence that the malignant growth had its origin in the muscle fibres, and Dr. Andrews' specimen supported this view.

Dr. ANDREWS (in reply) said that if Bumm's assertion, quoted by Dr. Spencer, that sarcoma developed in 12 per cent. of fibroids was correct they would have to modify their practice and remove all fibroids from middle-aged or elderly women whether they were causing trouble or not.

Lipomatosis of the Stroma of a Uterine Fibromyoma.

By H. RUSSELL ANDREWS, M.D.

THE patient was a multipara aged 38. Since a miscarriage four or five years before she was sent to me she had had excessive bleeding at the monthly periods, increased in severity during the last two years. The abdomen had been increasing in size for a year or more. For two months there had been swelling of the legs and puffiness of the face in the mornings. She was gravely anæmic, lemon-yellow in colour. The hæmoglobin was 20 per cent., colour index 3, red corpuscles 3,100,000. The urine contained albumin but no casts. A large tumour, apparently a tense cyst, rose out of the pelvis to a point above the umbilicus. The cervix was almost out of reach, and a soft, apparently fluctuating, swelling bulged deeply into the pelvis. The tumour was so soft that my resident physician thought at first that it was a distended bladder, and after passing a catheter thought that it was an ovarian cyst. I thought that it was a degenerate fibroid. After two and a half weeks the patient's general condition had improved a little, so I opened the abdomen and performed subtotal hysterectomy, removing one ovary which was enlarged. The cavity of the uterus was enormously enlarged by a tumour in the posterior wall. The tumour in its fresh state was 8 in. in diameter. On section it was a mass of golden yellow fat with a few white fibrous areas towards the centre. The patient made an uninterrupted recovery.

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[1] At a meeting of the Section, held March 3, 1921.

[2] The full report of this communication, together with the report of the Pathology Committee, will be published later.

Description of the tumour after it had shrunk: A uterus removed through the cervix, with a contained tumour forming a mass 15 cm. from above down by 17 cm. by 14 cm. The uterus has been slit up, and the tumour bisected and fixed in formalin. The tumour is rounded and as far as can be accurately measured in its present bulged state is about 14 cm. diameter. It lies in, and occupies the posterior wall of the body. It bulges into the cavity, and apparently filled it; the cavity being convex anteriorly, and stretched over the tumour. The endometrium is smooth, grey, and thinned out over the tumour, slightly thicker elsewhere. Cavity 13 cm. by 13 cm. Wall of uterus from 1·8 to 2·5 cm. thick. The cut surface of the tumour bulges, and is bright yellow and translucent. Tumour is elastic and tough; it looks like lipomatous tissue. There are a few slits in it, and a few white fibrous areas towards its centre. It is everywhere enclosed by a thickness of at least 1 cm. of muscularis. It contains a few follicular cysts up to 1·5 by 1 cm.

Microscopical sections: Intramuscular leio-myo-lipoma of uterus.

I think that there may be some difference of opinion about the manner in which fat became deposited in this tumour. In some places the fat can be clearly seen to be in the connective tissue. In other places there are small groups of unaltered muscle fibres lying surrounded by fat. I should have been content to call the tumour a fibro-myo-lipoma of the uterus, but Professor Turnbull says, "I should call the condition 'lipomatosis of the stroma of an intramural fibro-leio-myoma of the uterus.' It is an example of fatty infiltration of fibrous tissue."

Mr. Palmer has kindly supplied me with a description of the microscopical appearance of the tumour: "The section is taken from the centre of the tumour. The greater part of the section is occupied by lipomatous tissue. The fat is deposited as a large single globule which fills the cell. There are also areas and strands of tissue partly or completely free from fat cells. In these areas the muscle fibres are sparse and lie in a matrix which is to a large extent homogeneous and stained yellow, but contains delicate yellow and, less abundant, pink fibrils. The appearances are those of an œdematous fibromyoma. Very small areas of such œdematous fibromyomatous tissue are seen between fat cells of the lipomatous tissue. Further, single muscle fibres or small groups of muscle fibres frequently lie between the fat cells of the lipomatous tissue. These appearances favour the view that it is the cells of the interstitial tissue that have become lipomatous cells."

DISCUSSION.

Dr. HERBERT WILLIAMSON said that it was an interesting specimen and whatever name was given to the appearances here seen the condition was little if anything in common with the ordinary fatty degeneration of muscle and connective tissue cells. Last year Mr. Brockman and he read a paper before that Section upon a similar case, under the title of "Fibro-myo-lipoma of the Uterus," and gave reasons for rejecting the views put forward by Dr. Lockyer in his classical work on "Fibroids and Allied Tumours." They re-examined Dr. Lockyer's specimen and concluded that the large fat globules were not within but were lying upon the muscle fibres and had been dissolved out of the lipoma cells in the preparation of the sections. Dr. Williamson saw no difficulty in accepting the view that the fat cells originated from the connective tissue cells of the fibroid, because the development of sarcoma cells from the muscle fibres had already been proved. The question, however, was not definitely settled, for no one had yet succeeded in discovering in these tumours forms intermediate between the typical fibrous tissue and the typical signet-ring fat cell.

Mr. PALMER said that his experience in cutting sections of the fatty fibroid shown was the same as that of Dr. Williamson in cutting sections of other similar tumours. The fat globules invariably spread over the section and at first sight appeared as though they might be in the muscle cells, but examination showed that the fat globules were actually lying on the section and that the muscle cells contained no fat. They had not seen any transition forms in this tumour. The connective tissue cells, which contained fat, were completely filled by a single large globule. They used the term "Lipomatosis" because the microscopic picture closely resembled that of connective tissue cells in other regions when they were completely infiltrated by fat.

The PRESIDENT said that demonstration of the structure of this rare tumour had been excellent, and he agreed with Dr. Russell Andrews in his interpretation; his own opinion was that in this instance fatty degeneration of the fibroid might be excluded.

Dr. ANDREWS (in reply) said that he thought that in his tumour the process was too far advanced for one to expect to find transition stages of deposition of fat in the connective tissue cells. To prove that the condition was one of gradual deposition of fat in the connective tissue cells it would be necessary to examine a tumour in which the change was not so far advanced.

Acute Puerperal Salpingo-peritonitis.

By ALECK W. BOURNE, M.B., B.Ch., F.R.C.S.

THIS paper is a record of personal observations of a disease of which I have seen and treated many examples during the last year or so. It is necessary to explain the name I have adopted for a well-known condition. "Salpingitis" is not enough, while "salpingo-oöphoritis" is often wrong, especially early in the disease, but "salpingo-peritonitis" duly emphasizes the essential peritoneal factor in the pathology and treatment. Further, I am chiefly concerned with acute salpingitis, occurring in a previously healthy tube, which appears to me to be more common than is generally supposed, and which gives rise to the characteristic clinical picture about to be described.

If the condition is an exacerbation of previous tubo-ovarian disease, such chronic changes must of necessity have been slight for pregnancy to have occurred, and any such exacerbation largely takes on the form of an acute suppurative salpingitis of recent origin. Acute puerperal salpingitis differs in so many aspects from that of non-puerperal origin, particularly as regards the physical signs and treatment, that it should be considered as a separate disease.

The general physiological state, together with perhaps an altered resistance to infection, are important factors, distinguishing the puerperal from the non-puerperal woman, but the fundamental difference which is responsible for its individual consideration is anatomical; it lies in the peculiar anatomical conditions of the abdomino-pelvic organs during the first fortnight after labour. Essentially, the tubes are abdominal and not pelvic organs, and they are usually affected before they have reached their normal positions in the pelvic cavity.

By the end of the first week when symptoms are generally manifested, the tubes lie at, or just above the pelvic brim, in relation with the iliac vessels, while the ovaries are placed below, just within the pelvis, and applied to its lateral walls. The former are, therefore, outside the limitation of the pelvic basin, and are surrounded by coils of small intestine; this considerably alters the results which will follow the escape of pus from the abdominal ostia, as compared with a similar tubal condition in which the tubes are lodged within the pelvic cavity. In the latter case, as is well known, the resulting abscesses are strictly circumscribed in the pouch of Douglas, and the whole inflammatory area tends to be roofed in and delimited by the omentum or small intestine. General extension of the infection into the abdominal peritoneum is unusual, and the symptoms and signs are correspondingly localized. Resolution is a frequent result, the patient recovers without operation, and may regain a fair state of health. But conditions differ in puerperal salpingitis. The abdominal situation of the tubes is the cause of an abdominal as opposed to a pelvic peritonitis, since it allows the outpouring of pus amongst the coils of small intestine at or just above the level of the sacro-iliac joint, and herein lies the essential difference between the two varieties of salpingitis, a difference which is manifest as much in the physical signs exhibited as in the treatment required. Further, the hyperæmic condition of the uterus and appendages during the puerperium will also share in modifying the gravity of the symptoms and the rapidity of their course.

The involution of the uterus appears to be arrested in all these cases at a point at which the fundus extends about halfway between the symphysis and the umbilicus. This may be due to the presence of infection within its cavity or possibly to a neighbouring active suppuration in the tubes, but the important result is that the tubes are maintained at their high level at or above the brim of the pelvis for a considerable time after the inception of the disease. Moreover, the large uterus nearly fills the pelvic cavity and affords a fixed point comparatively high up in the abdomen proper for the development of adhesions with other parts.

The morbid anatomy is well seen when operation is undertaken in the acute stage. The tubes are seen to be greatly congested and œdematous, especially the ampullary portion, while the fimbriæ are protruding, and the ostium is discharging pus. The isthmus may appear to be quite normal or swollen to a less extent. Any adhesions at first are light and easily separated, often being due to flakes of recent lymph, and chiefly involving adjacent coils of small intestine and part of the cæcum or pelvic colon.

The abdominal ostium frequently opens into a small abscess cavity walled in by the adherent coils and situated at first just in front of and above the sacro-iliac joint. Later, when suppuration has extended, it tends to pass forward along the brim of the pelvis towards the uterine cornu, and is shut in from above by the omentum; or the pus may even come into relation with the abdominal wall, and I have seen eruption of the abscess through the parietal peritoneum into the layer of fat beneath the rectus.

It is noteworthy that the pouch of Douglas early becomes obliterated in nearly every case by a light adhesion of its anterior and posterior walls, extending to the depths of the fossa, and eventually preventing the formation of a deep abscess. This point is of considerable importance both as regards the physical signs and the technique of the operation, for it is in sharp contrast to the condition present in ordinary non-puerperal salpingitis, when inflammatory collections appear at the lowest part of the pouch. In puerperal salpingo-peritonitis invasion of the pouch of Douglas is secondary to the extension of pus from the primary focus at the ostium of the tube as it burrows from above downwards along the postero-lateral wall of the pelvis. It is only at the delayed operations that the fossa is found to contain an abscess, and then not in its depth, but spreading from the infected ovary. Similarly the utero-vesical pouch may be effaced in whole or part by the adhesion of the bladder to the anterior uterine wall.

A secondary condition sometimes found in cases operated on at a later date is a cellulitis of the upper part of the broad ligament which has spread forward from the mesosalpinx to involve the tissue beneath the round ligament. Under these circumstances the upper part of the broad ligament becomes an indurated dome-shaped mass, limited behind by the tube and in front by the round ligament, presenting an upper triangular surface having its apex at the uterine cornu. Later the infection affects the cellular tissue in front of the round ligament, which then takes up a position riding over the convex surface of the cellulitis. It is common also for the inflammatory process to extend over the pelvic brim into the iliac fossa, and also along the infundibulo-pelvic ligament as in ordinary parametritis. A mild degree of œdema is common in the mesosalpinx in the earliest cases, but it may be the forerunner of an extending cellulitis, as I have stated. When suppuration occurs here it tends to point just external to the uterine cornu in the angle between the round ligament and the tube. It is this which sometimes accounts for the firm adhesion of the uterine cornu to the omentum or abdominal wall, and furnishes an important physical sign in the shape of a localized point of exquisite tenderness just external to the lateral edge of the uterus.

Suppuration of the ovary can arise in three ways. First, it may be a late result of acute purulent salpingitis after adhesion with it has occurred, as is commonly seen in the gonococcal cases; secondly, it may be an exacerbation of an old condition of salpingo-oöphoritis; and, thirdly, it may proceed from the wall of the gut by direct extension. This is the only explanation I can give of a case upon which I recently operated. The tubes in this patient were perfectly normal, lying just above the pelvic brim, but the left ovary, which was not the subject of old inflammation or adhesions, was fixed by its convex border to the pelvic colon, which, at this point, was indurated and œdematous. On separating the two a small collection of about half a drachm of pus was liberated. Evidence of the gut as a direct channel of infection is also supplied by another case of suppurative salpingo-peritonitis, where *Bacillus coli* was grown only from the peritoneal abscess, and not from the tube or uterus, which yielded streptococcus and gonococcus respectively.

The spread of pus infection to the normal ovaries is a serious matter, as it is difficult to eradicate when once established, short of removing the organ. Moreover, it is ovarian infection in these cases which is the starting point of a descending suppuration. The first mass that can be felt by vaginal or rectal examination is the infected ovary surrounded by adherent coils or omentum. From this initial peri-ovarian abscess pus spreads downwards to form a collection in the para-rectal fossa. Later the ovary can be felt as an enlarged mass due to its containing an intra-ovarian abscess.

The subsequent morbid anatomical changes can be studied during the delayed operations. Then it is seen that the chief change has been the formation of dense adhesions involving all the pelvic organs together with the omentum and intestine. Especially are the tubes and ovaries firmly bound down to the large uterus and pelvic brim. Suppuration tracks in all directions, causing large peritoneal abscesses, and the ovary may be converted into a large pus sac. General suppurative peritonitis appears to be rare as the result of purulent salpingitis, though we know that it is not uncommon in trauma of the uterus in labour or abortion, and it is sometimes seen in septicæmia.

The bacteriological examinations of my cases have been too few to justify any conclusion in this respect, but four cases have all grown streptococci, with gonococci once, and *Bacillus coli* also.

Regarding the cause of the disease we know that it is due either to extension of organisms along the tube from the infected uterus, or to an exacerbation of previous salpingo-oöphoritis, which must necessarily have been only slight in degree, or unilateral. That extension of organisms does frequently occur is certain, and is easily understood. But I believe that the disease is sometimes caused by organisms that have lain dormant for a long time in otherwise perfectly normal tubes, and the following case proves this.

Some two years ago a patient underwent a Cæsarean hysterectomy at the commencement of labour, deliberately undertaken by Mr. C. W. G. Bryan at St. Mary's Hospital. The tubes were divided and ligatured in the ordinary way at the uterine cornua. The convalescence was normal and undisturbed till the end of a week, when she developed signs of acute lower abdomen illness. We reopened the abdomen together, and found both tubes in a state of acute purulent salpingitis, with pus leaking from them into the usual peritoneal abscess cavities situated around the abdominal ostia. The tubes showed absolutely no trace of old adhesions, and the fimbriæ were separate and protruding around the ostium as a result of œdema. Moreover, Mr. Bryan assured me that there was at the first operation no sign of salpingo-oöphoritis.

This case proves conclusively that the disease can arise entirely independently of post-partum uterine infection, for here there was no uterus at all; and also that potentially dangerous microbes can lie quiescent in an apparently normal tube. I believe also that, ordinarily, the tube can inhibit the growth of microbes within its lumen at ordinary times ; for instance I have succeeded in growing streptococci from the peritoneal abscess cavity around the tube and from the uterus, but have failed to cultivate a microbe from the pus within the tube in the same patient. But during the puerperium this defensive mechanism—if there be any, in fact—appears to deteriorate, and allow an outburst of organismal growth previously held in check.

The symptoms are those commonly complained of in an acute lower abdominal peritonitis, and therefore call for little comment. A few points, however, may be emphasized. Like acute appendicitis, pain precedes everything, and is rapidly followed by a slowly rising temperature becoming 102° or 103° F. on the third or fourth day, with a pulse following suit. Vomiting is not a feature in the early cases. An interesting and indicative symptom, occasionally present, consists in retention of urine or painful micturition. This is specially seen in cases in which a cellulitis has developed secondarily to the salpingitis involving the upper part of the broad ligament and extending forward beneath the round ligament to the neighbourhood of the bladder. If the patient is not operated upon there is a persistent fever with chronic pain and wasting ; she slowly goes downhill, develops cardiac weakness, and becomes bedridden.

The physical signs require more detailed description. In the early stages the abdomen is not truly rigid, and there is nothing but tenderness fairly accurately localized to a point about 2 in. below and external to the umbilicus—i.e., over the posterior part of the lateral brim of the pelvis. The fundus uteri can be felt rising about 2 in. above the symphysis. It may or may not be tender at first, but later it becomes so, especially if adhesions become attached to the cornua or if a secondary cellulitis develops.

After a week or more it is not unusual to find a mass in the hypogastrium to one side of the fundus uteri. Excepting cellulitis, which is felt immediately above Poupart's ligament, such a tumour is nearly always due to adherent omentum and coils of distended gut. Later, as suppuration spreads, there is true rigidity and tenderness of the whole hypogastrium, with extension upwards over the ovarian veins, if thrombosis of these vessels has taken place.

By way of the vagina the signs are difficult to appreciate, for the primary changes are not in the pelvis and the gentlest manipulation causes pain. The uterus can be felt enlarged, with limited mobility soon developing, and later complete fixity. In the first few days it is symmetrically disposed in the pelvis, but later it may be displaced laterally by secondary cellulitis, and the displacement is towards the side which is affected.

During the first week there may be little or nothing felt in the lateral fornices, but later an indefinite tender mass can be felt very high up in the postero-lateral region which is largely made up of the ovary surrounded by adherent coils enclosing pus. The accessible part of Douglas's pouch seldom, if ever, contains anything, though by the vagina the posterior portion of the lower part of the uterine body may give the impression of a tumour, because it tends to bulge backwards immediately above the cervix. By far the best palpation of the pelvis is obtained by rectal examination. High up on one or both sides the early composite swelling can be made out fairly early, becoming larger and more distinct as time passes.

A swelling high up in the broad ligament disturbing the position of the uterus is probably a mass of secondary cellulitis.

The treatment of this disease is, perhaps, the most interesting part of its discussion. Whether or not operation should be done is a question less contentious than *when* it should be done. In the great majority of these patients there is no doubt that operation is necessary, for the condition is essentially one of suppurative peritonitis, which, unless relieved, will show no tendency to undergo spontaneous resolution. The condition is totally different, as we have seen, from the ordinary acute gonococcal salpingo-oöphoritis where the whole process is confined within the limits of Douglas's pouch, and where also experience has shown that almost complete resolution is possible in the majority of cases. Moreover the peccant organism in puerperal salpingitis is frequently a streptococcus which the peritoneum is far less able to tolerate and suppress than the gonococcus. Further reasons for operating are that the tubes being subinvoluted, soft and distensible, are more liable to develop into pus sacs, while the involution of the uterus is permanently delayed, probably laying the foundation of a chronic hypertrophy. But the time at which operation should be performed is the point which admits of difference of opinion.

My own view is that puerperal salpingo-peritonitis should be operated upon as early as the diagnosis is established, and the reasons upon which this opinion is based are as follows:—

(1) If radical treatment is delayed the general condition of the patient rapidly deteriorates. There is loss of flesh and strength amounting later to emaciation, with the danger of cardiac failure following subsequent operation as a *dernier ressort.*

(2) The ovaries, which at first are free from suppuration, are prone to develop small abscesses, and later become disorganized. When once the ovary has become the seat of a pus infection, it is extremely difficult to eradicate it without removing the whole organ. And if such an ovary is left *in situ* it becomes a source of chronic pelvic trouble.

(3) With delay in operating the adhesions become tougher, and more difficult to separate; this involves risk to the gut, more extensive raw areas, and more time to complete the operation. Strong adhesions entail a serious additional risk to the operation.

(4) The tubes become thoroughly disorganized and incapable of repair. The delicate ciliated epithelium is desquamated, granulation tissue takes its place and the walls become permanently thickened. The tube as a whole becomes densely adherent to the ovary, the uterus and lateral wall of the pelvis. Removal of such a tube may be an almost impossible task without injury of the gut or even ureter, and yet if these appendages are left *in situ* the patient's convalescence may drag on for months or even a year with a chronic sinus and emaciation.

(5) The peritoneal abscesses extend and may reach the abdominal wall, especially over the uterine cornua. In one patient upon whom I operated, the pus had actually tracked through the peritoneum and had formed an abscess in the panniculus beneath the rectus.

(6) Secondary cellulitis of the upper part of the broad ligament may develop if the condition is not relieved by operation. This sometimes goes on to pus formation pointing at the cornual angle. Cellulitis is a serious extra burden upon the patient; it delays convalescence, adds fresh possibilities of grave trouble because of its dangerous lines of extension; it tends to produce thrombosis of the ovarian veins, and is liable to leave behind a legacy of chronic pelvic pain.

Almost any one of these reasons is sufficient, but taken together they certainly make out a good case for early operation. The disease is quite different from acute gonococcal salpingitis, and the objections to early operations in this condition do not obtain here.

The operation itself should be done with great care, and sound judgment to determine the exact procedure required by each individual case is necessary. After the abdomen is opened and the cut edges of the peritoneum clipped to towels the upper part of its cavity must be thoroughly packed off by gauze in the usual way. Obstructing adhesions are then separated and the region of the abdominal ostia of the tubes is sought as it is here that a peritoneal abscess will most likely be found. Great care should be taken not to disturb the light adhesion which has probably obliterated the pouch of Douglas and possibly also the utero-vesical pouch. The tubes and ovaries are inspected to note particularly whether the infection is entirely recent, or whether there is evidence of old inflammatory trouble. In the former case the ostium will still be patent, surrounded by œdematous fimbriæ and if the tube be gently squeezed pus will exude from its open end.

Now such a tube is a potential pus sac but at the same time it still possesses a mucous membrane, capable of restoration to a functioning condition, provided that operation is undertaken during the first few days—this point can easily be demonstrated microscopically. Therefore, to leave the tube alone is to invite chronic inflammatory changes. perhaps a pyosalpinx, with their train of chronic pelvic symptoms, whereas removal of the tube at this stage is too radical a measure for an organ which is capable of complete restoration. The *via media*, and correct surgical treatment, I believe, lie in permanently laying open the tube in order to drain it. Scissors should be made to enter at the ostium and the ampulla. This procedure is exactly comparable to the laying open an ill-draining abscess cavity with the object of terminating the suppuration and preventing further damage by the continuance of a subacute inflammation set up by the presence of pus under a certain degree of tension. The ostium, while it remains patent, is incapable of affording free drainage of tubal contents, and, as in septic infections, the fimbriæ soon adhere and close the opening. Salpingostomy immediately destroys the tube as an abscess cavity, but does not destroy it in its capacity as a future ovum-bearing channel, provided that it is done at an early stage of the disease. Further, by checking the suppurative and inflammatory processes within the tube not only is a pyosalpynx rendered impossible but there is no longer a tendency for the formation of chronic interstitial salpingitis with permanent closure of the ostium and complete destruction of the ciliated epithelium.

I have recently had occasion to learn that an acutely suppurating tube can undergo complete resolution after salpingostomy. A patient in whom I carried out this operation on the left side at the Willesden Municipal Hospital developed pneumonia and died about a month after. At the autopsy I found that this tube had completely resolved. It had shrunk to the normal size, and its gutter was lying open, while it had contracted absolutely no adhesions. This was in spite of a small chronic abscess holding about half a drachm of pus between the ovary and lower part of broad ligament. I was much impressed by this case, as originally the tube was in a condition of acute suppurative salpingitis, from which streptococci were cultivated.

If, however, the tubes and ovary show signs of former inflammation and are bound down and give no promise of ever being able to function again, they should be removed in the ordinary way. Otherwise they are liable to furnish chronic foci of suppuration and the patient's convalescence is immensely prolonged. The delayed operation—i.e., performed after two or three weeks—may be difficult and dangerous on account of the appendages being enveloped in very dense adhesions. There is now little hope of saving the tubes; in fact, it is usually necessary to remove them to ensure a reasonably quick recovery. Mere drainage of the peritoneal abscess cavity is not sufficient.

Secondary cellulitis of the upper part of the broad ligament should be incised radially from the cornu between the round ligament and the tube, and explored by a sinus forceps. Pus is frequently found, but if not the escape of serum and œdematous fluid materially hastens subsidence.

Before closing the abdomen the suppurating areas should be drained.

The general principles, therefore, in operating on acute puerperal salpingo-peritonitis are to employ conservative measures on structures in an acute condition in order, first, to save them and, secondly, to prevent chronic changes developing in them; but to deal radically with acutely inflamed and seriously damaged appendages in spite of dense adhesions which may be present. In this way much can be done to conserve function, to prevent chronic disease and to provide for a reasonably quick recovery to normal health.

The PRESIDENT said that he recalled his own early experiences as an operator in three of these rare cases, after delay and the formation of dense adhesions. The morbid condition had always been rare: it was now almost unknown. Mr. Bourne had described its pathology and clinical features correctly and he (the President) had long been convinced of the need for a prompt operation with the more conservative prospect Mr. Bourne had indicated.

Section of Obstetrics and Gynæcology.

President—Mr. HENRY BRIGGS, F.R.C.S.

Vascular Change during Uterine Involution: A Study of the Condition of the Arteries in a Uterus removed Twenty-four Days after Delivery.[1]

By GEOFFREY EVANS, M.D.

DURING the past seventy years many observers have made a close study of the histological changes that occur in the uterine vessels in the course of normal involution of the uterus after labour. It would seem that after so much inquiry there can hardly be any aspect of the subject in dispute or new observation to be made. In recent years a very complete research into this subject has been carried out by Dr. James Goodall,[2] and both on account of its intrinsic merit and the fact of its being quoted at length in Eden and Lockyer's "New System of Gynæcology"[3] it may be accepted as the standard work on the vascular changes that take place in uterine involution. The present communication deals with a single aspect of this subject—namely, the presence or absence of fatty degeneration in the muscle fibres of the arteries of the uterus undergoing involution.

The majority of past observers have found that fatty degeneration does occur both in the muscle fibres of the uterus and the muscle fibres of its vessels. In fact, there is no need to make any distinction, in dealing with this subject, between the muscle fibres in the two tissues, because there is no record of fatty degeneration occurring in the one group of muscle fibres while absent at the same time in the other group; the converse also holds good. Some have noted the appearance of fatty degeneration at an earlier stage in the puerperium than have others, but there has been little difference of opinion as to the fact of its occurrence. Goodall agrees with the majority of past observers and notes the presence of fatty degeneration in the muscle fibres of the uterus and arteries of the uterus, and states that "the muscle cells of the parent media undergo fatty degeneration at an early stage in the process of involution."

DESCRIPTION OF THE CASE.

Dr. H. Williamson has kindly given me the opportunity of preparing specimens from a uterus removed at operation twenty-four days after delivery of a dead fœtus. The case was that of a patient, aged 41, admitted to St. Bartholomew's Hospital under Dr. Williamson on September 6, 1919, on account of bleeding from the uterus and twenty-five weeks gravid. She was found to have a carcinoma of the cervix which extended up to, but did not involve, the posterior vaginal wall. The patient had had eight children, with straightforward labours and no miscarriages. The menstrual history was normal. The present pregnancy was normal until the onset of bleeding in April. On September 17, under general anæsthesia, the membranes were ruptured and abortion induced. At 2 a.m. on September 20, that is in the twenty-seventh week of the pregnancy, abortion took place. The fœtus was born dead, but not macerated. On October 14, twenty-four days after the delivery of the dead fœtus Wertheim's hysterectomy was performed and the uterus removed.

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[1] At a meeting of the Section, held March 3. 1921.

[2] "The Involution of the Puerperal Uterus," *Amer. Journ. Obst.*, 1909. lx, pp. 921-985.

[3] "New System of Gynæcology," ii, 1917. p. 131 *et seq.*

The organ was placed in formol-saline, and at a later date parts of it were removed for section. The separate parts were embedded in gelatin according to Dr. J. F. Gaskell's method and cut frozen. Sections were stained in Sudan III and acid hæmalum, others in Van Gieson and acid hæmalum, and others in Weigert's elastica and eosin. The advantages of the gelatin method of embedding are that the tissue is not raised to a higher temperature than 37° C., and is not brought into contact with xylol; as a result the cells retain their normal form more nearly, and any fat present is not dissolved out of the tissues.

The sections thus prepared show the usual changes in the vessel walls characteristic of normal arterial involution. The most striking changes occur in the intima; there is a cellular proliferation and hyaline swelling of the subendothelial layer, together with a swelling and splitting of the internal elastic lamina. In the media there is the appearance of a granular atrophy of the muscle fibres and a hyaline swelling of the intermuscular connective-tissue fibrils.

REMARKS.

The picture has been often described and does not require detailed notice; in fact, the only point to which I would draw attention is the absence of any sign of fatty degeneration either in the medial coats of the vessels or in the muscle fibres of the uterus. The histological picture of the vessels in this specimen are in all respects comparable to the changes seen in the involution of the hypogastric and umbilical vessels after birth. I have examined many specimens of these vessels up to two years after birth and have not observed fatty degeneration occurring in the media in any vessel. Neither does fatty degeneration occur in the involution of arteries after ligature or thrombosis, nor in the normal involution of the ductus arteriosus; in fact, so far as I am aware fatty degeneration is not a normal feature of arterial involution. It would appear that it is only in uterine involution that fatty degeneration occurs in vessels undergoing this physiological change. The absence of fatty degeneration in my specimen is therefore in accord with the general observations on the changes that take place in arterial involution, and it further establishes the fact that fatty degeneration need not of necessity occur in uterine involution.

The presence or absence of fatty degeneration in uterine involution is a matter of importance to a proper understanding of the processes involved in the varied arterial lesions described under the term of "arteriosclerosis." Thus Thoma maintained that slowing of the blood stream was a dominant factor in the production of arteriosclerosis, and he based his theory largely on the change occurring in the iliac and hypogastric arteries of newly-born infants. Thoma's theory of arteriosclerosis is chiefly concerned with the process of involution. The weightiest single piece of evidence against this hypothesis is the characteristic presence of fatty degeneration in the histological picture of arteriosclerosis and its absence in normal involution. But this distinction will fail if it is established beyond doubt that fatty degeneration occurs in the media of arteries undergoing involution in the puerperal uterus. I do not feel that it is expanding the subject too far in applying the observations on arterial changes in uterine involution to the wider subject of arteriosclerosis, because Goodall follows his observations to the same goal, and in discussing their bearing on arteriosclerosis he concludes by stating that his work seems to prove that both Jores and Thoma are right in their views as to the nature of the processes underlying the production of arteriosclerosis.

A CRITICAL EXAMINATION OF CURRENT VIEWS.

It is difficult to dismiss the work of past observers who have found that fatty degeneration always occurs in uterine involution, and at the same time in their writings there is not, in general, sufficient detailed information given to allow of adequate criticism of their material or methods. As regards my own specimen it may be objected at once that the pregnancy had not gone to full term and that the organ was in a condition of subinvolution. This criticism is fair, and one of my objects in bringing this matter forward is the hope that it may lead to my having better material to examine on a future occasion. The criticism, however, loses some force in that fatty degeneration is absent in my specimen: had it been present it might have been ascribed to subinvolution, but subinvolution cannot account for its absence. In the second place the criticism fails to an extent because the material of those who have found fatty degeneration in the muscle fibres of involuting uteri is also abnormal. I have not read any account of arterial changes in human uterine involution which avoid this criticism.

It would take too long to justify this statement in detail, but to illustrate my meaning I will take Dr. Goodall's research. It is based on the examination of eighty uteri, but the observations on the subject of the changes that occur in the puerperal uterus are based on only six cases. Goodall states that five of these showed subinvolution; in the sixth there was a morbid lesion, which one would expect to interfere with the process of normal involution.

It is a mistake to regard Goodall's observations as a record of the changes that occur in normal uterine involution, for he states on p. 61 of his monograph that "all the chronic inflammatory diseases, blood dyscrasias. . . . and possibly malignant growths modify the normal complete involution." As there is no doubt as to the truth of this statement it is fair to assume that any unexpected histological features presented by uteri taken from cases in which any of these conditions were present are capable of explanation in terms of a pathological process rather than in terms of the physiological process involution. Further, in the six cases on which Goodall based his observations the cause of death was in all cases due to a disease which might in itself have caused both vascular disease and fatty degeneration in muscle fibres. Thus Case 1 died of "eclampsia, associated with, or caused by, a very grave chronic parenchymatous nephritis." Case 2 died of "syphilitic arteritis of the brain." Case 3 died of "septicæmia, secondary to an abscess of the breast with subinvolution." Cases 4 and 5 died of tuberculosis of the lungs, while Case 6 died of "acute yellow atrophy of the liver, chronic parenchymatous nephritis, and broncho-phthisis incipiens." An interesting comment is made on this case, for the author writes: "Hence it is seen why Case 6, who had had chronic Bright's disease, followed by acute yellow atrophy of the liver, should present such intense degree of incomplete oxidation of tissue," and in another paragraph that "such cases must be looked upon as abnormal." It is obvious that the author recognized his material as being pathological, and he cannot be blamed for his work being mistaken for an account of the changes that occur in normal involution. When a condition of suboxidation exists fatty degeneration may be expected to occur, and therefore before it is established that fatty degeneration is a part of the normal process of uterine involution it must be found to occur in a uterus taken from a healthy subject. Further, as regards the presence of fatty degeneration in the media of the vessels, it must be proved that the other vessels in the body are normal in order to exclude the possibility of the local vascular fatty degeneration being part of a diffuse vascular disease. This last condition will be fulfilled, in my opinion, if the intimate vasculature of the spleen and kidney are found to be normal, because I have found that diffuse vascular disease tends to have its chief incidence on these two organs.

CONCLUSION.

It must necessarily be difficult to obtain material from the human subject which will satisfy these conditions, and in the meantime we must rely on observations made on uterine involution as it occurs in animals.

Such observations have been made on rabbits.

Broers found that fatty degeneration occurred in the muscle fibres of the uterus between the third and thirteenth day of the puerperium; no reference was made to its presence or absence in the media of the vessels. Helme made similar observations on ten rabbits, and since his work was primarily directed to this question it is of particular importance. He thus states the object of his research: "The prime question that presents itself is: Does a degeneration of muscle cells occur?" His answer is: "I have been unable to find a single muscle cell whose substance gave the characteristic appearances and reactions of fat," and later he speaks of the occurrence of a gradual diminution of the volume of the muscle cells of the media, "just as in the muscle cells of the uterine wall."

Too close a parallel cannot be drawn between the changes that occur in uterine involution in animals and those that occur in the human subject. There is also a conflict of observation. I think, however, that the conclusion is justified that the question of the presence or absence of fatty degeneration in the media of the vessels in the puerperal uterus is not as yet definitely settled.

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Dr. HERBERT WILLIAMSON said that Dr. Geoffrey Evans' communication was both interesting and important. He had clearly shown that the question of fatty degeneration during the normal involution of the uterus was by no means settled, and that its absence in involuting arteries in other situations certainly supplied ground for scepticism on this point. As Dr. Evans had pointed out, Goodall's fine piece of work was done on pathological material and therefore could not be taken as necessarily a true picture of physiological involution.

Section of Obstetrics and Gynæcology.

President—Mr. HENRY BRIGGS, F.R.C.S.

Angioma spontaneously evacuated from the Vagina.[1]

By HENRY CURTIS, F.R.C.S.

THE patient, a lady of somewhat poor physique, overwrought from mental and physical strain, collapsed from "nervous exhaustion" in June, 1905, when she was aged 32. At this time, too, she had had to lift a heavy weight. Possibly the over-strain, physical and mental, in a person of relaxed fibre, may have been a contributory factor in the trouble which followed four months later.

In October, 1905, for the first time, the patient became aware of a protrusion from the vagina, which persisted for a month, and then gradually receded. By April, 1906, it had completely disappeared. It again appeared in August, 1906, and thenceforward reappeared regularly about four or five days before each period, associated with aching pains across the back, at the bottom of the spine. In the latter part of 1907, the protrusion appeared about ten days before each period. The periods had been a little irregular in the summer of 1905, but were regular thereafter.

The protrusion was described as appearing in the form of two lobes; sometimes there was a third, or what seemed to be a third lobe. It was of a bright red colour; occasionally it turned a very dark red, almost black, but this seldom occurred. The size varied, but on two or three occasions it projected for half an inch or more, when it felt as if suspended from something inside. When the patient was walking or standing it was much more distinctly felt than when she was lying down, and then it generally receded. After her being in bed at night it disappeared, but on her rising it gradually projected outside again. When the period ceased the protrusion disappeared.

The patient consulted me in May, and again in November, 1907; she was extremely nervous, and, naturally, examination was not as complete and satisfactory as it would have been under an anæsthetic, especially owing to the complete disappearance of any external protrusion after menstruation, and the narrow hymeneal orifice, which was still further obstructed and reduced in size by an obliquely-placed bar-like septum.

The urethral orifice was seen to be normal, and showed no trace of a caruncle. Nothing abnormal could be detected within the vagina or external to the hymen.

At the third visit, January 22, 1908, the patient stated that at the end of the September period, and after some offensive discharge, a fleshy mass had been spontaneously expelled from the vagina. There was no noticeable hæmorrhage, but menstruation had only just ceased. She produced the specimen, the remnant of which, shrunken and embedded in paraffin, after being sectioned by Dr. E. H. Shaw, Director of Clinical Pathology, and Pathologist to the Great Northern Central Hospital, is now submitted for inspection by the Section, together with microscopical preparations and photomicrographs.

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[1] At a meeting of the Section, held May 5, 1921.

Examination at this visit, January, 1908, showed the urethral orifice to be normal. The vaginal outlet was again inspected, and as digital examination was inadvisable, the bar-like septum of the hymen was gently held aside by a sound. No trace of a pedicle, or any nævoid structure could be detected within the vagina or external to the hymen. Doubtless the septate condition of the hymen had strangulated the growth and helped to cut through the pedicle.

The patient returned in July, 1908, and reported that there had been no further recurrence locally.

The fleshy mass expelled was of a thin, flat, elongated ovoid shape, with one end pointed, the other having attached to it the remains of the shrunken pedicle, its outline and flatness reminding one of the marine animal familiar to us as medical students as the lancelet (*Amphioxus lanceolatus*). It was of a pinkish red colour, rather like a blood-clot. The specimen, shrunken during preparation and imbedded in paraffin, measures a little more than 1 in. by $\frac{1}{4}$ in., or more exactly, 2·7 cm. by 0·9 cm.

The clear history, and local examination of the urethra negative the growth having arisen from a caruncle. Though its surface has been denuded of epithelium, its origin from the vagina rather than from the cervix or body of the uterus is indicated by the absence of any glandular tissue and characteristic stroma.

REPORT ON THE MICROSCOPIC APPEARANCES BY DR. E. H. SHAW, M.R.C.P.

"The section shows a mass of vessels with thin fibro-muscular walls, and filled with blood. A narrow incomplete layer of badly stained, necrotic connective tissue is present on the surface. A few small round inflammatory cells are scattered throughout the growth. No mucous membrane or epithelial tissues can be made out. The tissue is thus made up almost entirely of blood-vessels and is therefore most probably a nævus (hæmangioma)."

In reply to my inquiry as to the probable origin of the growth, Dr. Shaw further reported:—

"There is an irregular patch in one place which suggests the framework of cervical glands seen in erosion; but the patient has never had a child, and therefore there is no torn cervix to account for such a condition. That can be excluded.

"A very vascular cervical or uterine polypus with a very long pedicle is a possible condition, but one would expect to see some remains of gland or muscular tissues in the body of the mass. There is none; and so this can be excluded. That brings us to the vaginal wall or hymen, and I think a nævoid hypertrophy of one of the rugæ of the vagina the most likely origin of the mass.

"The specimen is complicated by the excessive congestion of the vessels due to constriction, and so adds to the difficulty. I think on the whole there is sufficient evidence to justify calling the specimen a nævus."

In relation to true angiomatous growths of this region, Kelly and Noble, "Gynæcological and Abdominal Surgery," vol. i, 1907, say that:—

"Angiomata of the urethra are exceedingly rare if we exclude from this heading the urethral caruncle which from its rich supply of blood-vessels is sometimes considered an angioma.

"Varicosities and angioma formations of the vagina and vulva sometimes extend over the urethral structures."

Case of Carcinoma of the Uterus originating in an Adenomyoma.[1]

By H. Russell Andrews, M.D.

The patient was a single lady aged 52, who was sent to me in November, 1920, on account of loss of strength and energy and recurrence of bleeding after the menopause. The menstrual periods stopped completely three years previously after almost continuous bleeding for a year. In July, 1920, there was slight bleeding. In September there was four weeks' bleeding, with a flooding at the end of it. There had been no bleeding for a month before I saw her. She was well-nourished and had not lost flesh. She complained that for five or six months she had felt tired and had had some pain in the right iliac fossa. Lately there had been "neuralgic pain" in the lower abdomen. Nothing abnormal was found on abdominal examination. On bimanual examination the cervix was found to be normal; the body of the uterus considerably enlarged. On examination under an anæsthetic, the body of the uterus was found to be as large as three months' pregnancy. I thought that the condition was probably carcinoma of the body of the uterus with fibroids, and proceeded to perform hysterectomy. The operation was a very difficult one, as the rectum was adherent to the back of the uterus and the

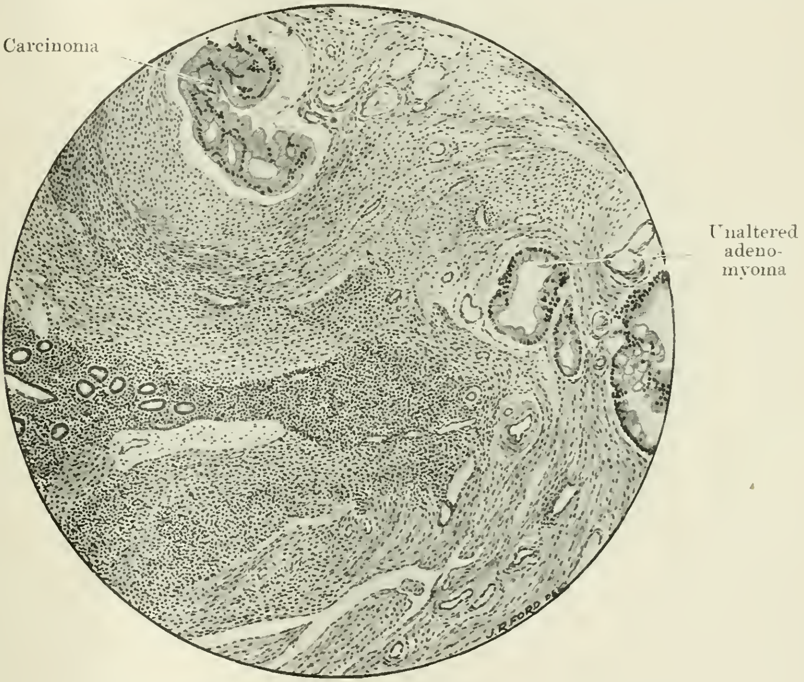

Fig. 1.—Showing unaltered adenomyoma and carcinoma in the same field.

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[1] At a meeting of the Section, held May 5, 1921.

parametrium was dense and inelastic, this making dissection difficult. The pelvic peritoneum was studded with minute nodules resembling miliary tubercles. Both tubes were considerably enlarged and contained caseous material. The patient made a good recovery, and when seen recently, five months after the operation, was in very good health.

Naked-eye Description of the Uterus and Tubes.—The uterus measures 12 cm. by 9·5 cm. by 9 cm. The peritoneum is covered with coarse fibrous tags and there are scattered over it raised solid pink nodules of various sizes, most of them very small. The wall is soft, except in the fundus and the right cornu where there are two rounded nodules which on section show a pink and white whorled surface and a few small cystic spaces. The endometrium is smooth and thin. The cavity of the uterus is irregular and enlarged. Both tubes are thickened and contain white or grey caseous matter.

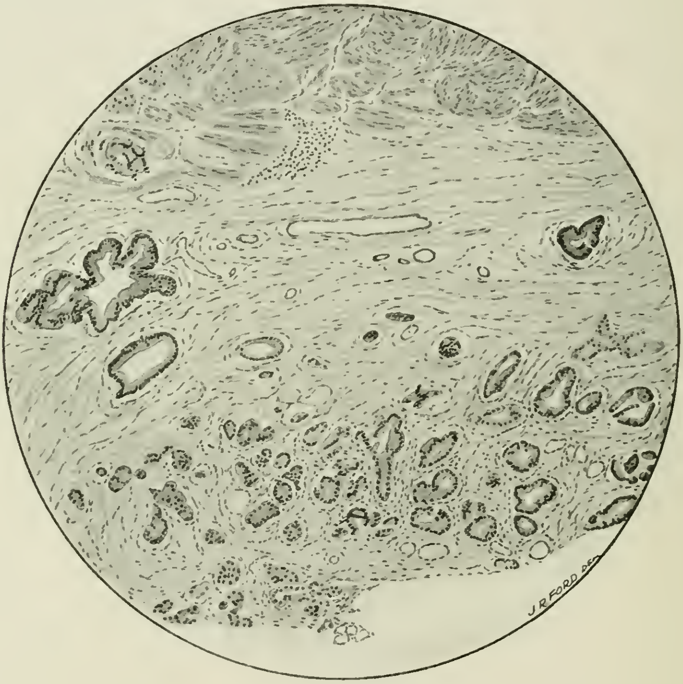

Fig. 2.—Secondary nodule in the musculature, and nodules and tubules in the peritoneum of the posterior surface of the uterus.

On naked-eye examination, as the endometrium was healthy, I hoped that there was no malignant disease, but microscopical examination showed that although the endometrium was healthy there was carcinoma in adenomyoma.

Microscopical Examination.—The endometrium is atrophic and shows no malignant change. Sections taken from various parts of the uterine wall show carcinomatous change in an adenomyoma. A few small areas of unchanged adenomyoma can be found (fig. 1). The nodules seen in the peritoneum consist of tubular or solid columnar-celled carcinoma (fig. 2). Both Fallopian tubes are filled with the same growth.

Cases of adenomyoma becoming carcinomatous with no carcinomatous change to be found in the endometrium are very rare. Cullen[1] says, "In spite of a rigid search I have failed to find among our own cases a single instance in which an adenomyoma has become carcinomatous." Lockyer, in his "Fibroids and Allied Tumours," quotes a few cases and says, that "adenomyomata may become malignant, but they do so very rarely."

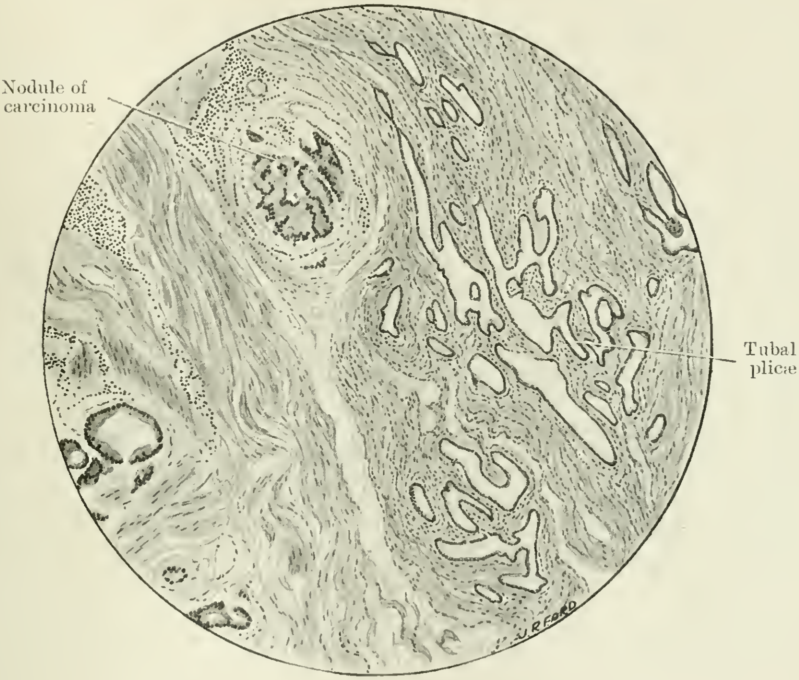

FIG. 3.—Nodule of carcinoma in the wall of the Fallopian tube.

DISCUSSION.

Dr. HERBERT SPENCER said that he hoped this interesting specimen would be submitted to the Pathology Committee. It certainly looked like cancer in an adenomyoma; but it was curious that the endometrium should be unaffected. He had never met with cancer in an adenomyoma; but in an enormous cystic adenomyoma, weighing about 70 lb., removed many years ago, he had found the cysts filled with masses of hyperplastic epithelium, which he thought at the time was cancer, but probably was simply papilloma with hyperplasia of the epithelium. This part of the tumour had had to be extensively enucleated from the cellular tissue and, as the patient was quite well seventeen years later, the disease could not have been malignant.

Dr. ANDREWS (in reply) said that the recurrence of bleeding three years after the menopause made him suspect malignant disease before the operation. He welcomed the suggestion that the specimen should be referred to the Pathology Committee and promised to have drawings of the microscopical sections prepared for the *Proceedings*.

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[1] "Cancer of the Uterus," p. 410.

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REPORT OF THE PATHOLOGY COMMITTEE.

Dr. Russell Andrews' specimen of carcinoma of the uterus originating in an adenomyoma was considered, and the Committee agreed with Dr. Andrews' description and found that a carcinoma had developed in an adenomyoma, the endometrium being normal to the naked eye and, microscopically, showing no malignant change.

Two Cases of Sarcoma of the Uterus.[1]

By H. RUSSELL ANDREWS, M.D.

I AM showing two specimens of sarcoma of the uterus, from patients recently under my care.

In the first case the patient had been known for twelve years to have a uterine fibroid. She had been examined on account of mucous colitis by two competent observers who both considered that she had a fibroid which was causing no symptoms and was of no importance. At the age of 65, after symptoms and signs indicative of rapid growth and malignancy for a few months, a large sarcomatous tumour of the uterus was removed; the uterus contained no other tumour. This seems to be clear clinical evidence that a fibroid had become sarcomatous.

The patient was a single lady, aged 65. For three months she had complained of frequency of micturition, difficulty in emptying the bladder, and a sensation of pressure on the rectum. During the same period she had been losing weight. She looked rather cachectic. For two months she had noticed increase in the size of the abdomen. There had been no bleeding nor discharge since the menopause. She had been told twelve years previously that she had a uterine fibroid, but she was never conscious of the presence of a tumour until ten days before she was sent to me. Sir John Phillips kindly wrote to me that six years previously there was a subserous fibroid, the size of an orange, which could not be felt by abdominal examination. I found a very prominent, firm, rounded tumour rising out of the pelvis to a point 2 in. below the umbilicus. Vaginal examination was impossible. On rectal examination it was found that a good deal of the tumour lay in the pelvis. It was almost fixed. The cervix was normal; the body of the uterus could not be differentiated. There was infiltration of the right uterosacral ligament. My diagnosis was either sarcoma of the uterus or malignant ovarian tumour. The patient was anxious to have the tumour removed if possible because of the discomfort from which she suffered, but I doubted whether it could be removed. I advised examination under an anæsthetic and operation if possible. I had the benefit of Dr. Herbert Williamson's help and advice in the examination under anæsthesia. The physical signs were as stated above with the addition that the body of the uterus could be made out lying to the left of the tumour and blended with it. When the abdomen was opened the bladder was found to be lifted up and to the left. The tumour was uterine, lying largely in the right broad ligament. Hysterectomy was obviously impossible, so the broad ligament was incised and the tumour shelled out, leaving the right cornu with tube and ovary on one side and the rest of the uterus on the other side. There was much induration of the cellular tissue in the right side of the pelvis and a large fixed gland on the right iliac vessels. The patient made a good recovery, which was retarded for a few days by infection of part of the wound, and she left the nursing home twenty-eight days after the operation.

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[1] At a meeting of the Section, held March 3, 1921. For Abstract and Discussion, see *Proceedings*, 1921, xiv, p. 305.

Description of the tumour from the Pathological Department of the London Hospital :—

> An almost rounded tumour, partly fixed in formalin, 15 cm. by 13 cm. by 10 cm. The outer surface shows rounded well-defined bosses, and is smooth except for fibrous tags. It appears to be encapsulated. There is one projecting nodule, attached by only one pole to the rest, and devoid of capsule. On section the tumour is divided into lobules that vary in size. These lobules have a homogeneous grey, brain-like appearance. A few of the lobules show a very faint whorling, with faintly differentiated translucent grey and pearly white bundles. Towards one end is a large area which is opaque and yellow. At one point on the surface of the growth there is a cord, 2·5 cm. long, of white tough tissue (growth) projecting from the surface. This is seen to project from a smooth-lined, blood-stained tube, evidently a vein in the growth.

The naked-eye appearance of the tumour is characteristic of sarcoma. I do not think that there will be any difference of opinion about the sections which are shown under the microscopes.

Mr. A. C. Palmer has kindly supplied me with the following microscopical description :—

> One section is taken from the most homogeneous portion of the tumour. The greater part of the section is occupied by atypical muscle tissue. In some areas bands of typical muscle fibre and connective tissue can be seen running through the section. In the atypical areas, muscle fibres are very abundant and they have their long axes disposed in all directions. Collagen fibre is for the most part absent, but a few small areas of fine pink fibrils occur among the muscle fibres. The muscle nuclei vary greatly in size and shape, and multinucleate formations are frequent. In another section, taken from a portion of the tumour which showed faint whorling, there are numerous interlacing bands of pink collagen fibre. In the spaces between the collagen fibre, atypical muscle cells are relatively scanty.

In the second case, a necrotic sarcoma of the uterus, a large amount of the tumour, of jelly-like consistence, was discharged into the peritoneal cavity through a hole in the posterior surface of the uterus.

The patient was aged 51 and had been married six months. For twelve months she had thought that she was getting stout. She had always lost rather profusely at the menstrual periods. A year before she came under my care she began to have occasional floodings, and for six months she had had almost continuous hæmorrhage, often passing large clots. For two months she had noticed a lump protruding from the vagina and for a week or two had had a very foul discharge. She was profoundly anæmic, hæmoglobin 35 per cent., red corpuscles 1,900,000. A hard, tender, rounded swelling filled the lower part of the abdomen, reaching up to just above the umbilicus. A necrotic, lobulated, pedunculated tumour, the size of a large walnut, protruded from the vulva, the pedicle being attached just behind the orifice of the urethra. The cervix was normal. The large tumour was evidently uterine. There was a horribly offensive discharge. I thought that the pedunculated vulval tumour was a sarcoma. As my colleague, Mr. Luker, was operating the next day, December 3, I asked him to remove it, and hoped that if the patient's general condition improved I might remove the uterus. Mr. Luker removed the vulval tumour which was said to be an inflamed, very œdematous fibromyoma.

The blood count improved slightly, but the foul discharge continued, the abdominal tumour became more tender, and the evening temperature varied from 99° to 101° F. There seemed to be no doubt that the tumour was undergoing necrosis. I thought that hysterectomy, if performed at once, would almost certainly kill her, but that if the uterus was not removed any further hæmorrhage would be fatal. It seemed best to try to make the interior of the uterus less septic before operating. Mr. Luker dilated the cervix on December 22 and inserted a finger, but could find no sloughing mass. He inserted two Carrel's tubes, through which the uterine cavity was irrigated with eusol. This had the effect of bringing the temperature down and diminishing the odour of the discharge. The tumour became much smaller until it reached only two-thirds of the distance up to the umbilicus, although no growth had been discharged into the vagina. On January 4 I performed hysterectomy, after packing the uterine cavity with gauze soaked in tincture of iodine. There was a good deal of soft, translucent jelly-like material, inodorous, in the peritoneal cavity, exuding from a hole in the posterior surface of the uterus. Glands along the common iliac vessels on the right side were noticed to be enlarged. The patient stood the operation as well as could be expected, and the wound healed well, but septic thrombosis ensued and she died four weeks later.

After examination of the uterine tumour the pathologist amended his original opinion about the pedunculated vulval tumour and called it a myosarcoma.

Description of the tumour:—

A uterus removed through the upper vagina. It is much enlarged, 14 cm. by 11 cm. by 4·5 cm. Peritoneum smooth throughout except for a soft red gelatinous nodule 1 cm. in diameter in right posterior wall of body. Uterus feels somewhat soft and doughy. The cavity is much distorted. In the right anterior wall pushing the cavity to the left, there is found a large nodular mass which has broken through the endometrium. It is 9 cm. across and is made up of soft nodules, grey or greenish-brown in colour, separated by narrow sunken lines. The green nodules have a somewhat ulcerated surface. Others appear to be covered by endometrium. On section this mass is found to consist of grey nodules, semi-translucent and separated by narrow zones of white firmer tissue. The cut surface bulges slightly, and around the nodules in the wall are similar small areas. The mass is for the most part definitely encapsulated. There are other small masses raising the peritoneum on the posterior wall. some of which have hæmorrhage within them.

Mr. Palmer has given me the following description of the microscopical appearances:—

The section is taken from the portion of growth which had invaded the endometrial cavity. The greater part of the section consists of atypical muscle. There are frequently large irregular spaces between groups of muscle fibres. Occasionally bands of typical muscle fibre and connective tissue can be seen running through the atypical muscle areas. The muscle fibres are very abundant, their long axes are disposed irregularly. The nuclei vary greatly in size and shape, and giant cell formation is frequent. Fine pink collagen fibrils are almost completely absent from the true cellular atypical muscle areas.

REPORT OF THE PATHOLOGY COMMITTEE.

Dr. Russell Andrews' specimen of sarcoma of the uterus arising in a fibromyoma was considered, and the Committee agreed that there was no doubt that it was a case in which sarcoma had developed in a fibroid.

DISCUSSION ON THE CAUSES, PROGNOSIS, AND TREATMENT OF STERILITY.[1]

Dr. Arthur E. Giles

said that the subject of sterility in women did not derive its importance from considerations of the preservation of health or the saving of life, as was the case with many subjects in obstetrics and gynæcology. Its importance had other sources, not less worthy of the careful attention of the medical profession, and recognizable as being of two kinds, the one concerning the welfare of the State, and the other the happiness of the individual.

A nation with a falling birth-rate was usually a decadent nation; and a falling birth-rate, though doubtless in a measure dependent on social and economic conditions, was partly the result of sterility, which, in turn, was in some degree preventable or curable.

On the other hand the childless home lacked one great source of human happiness and one great factor in the welding together of ideal family life.

As members of the medical profession, and especially as exponents of the diseases of women, they could do something towards the prevention and cure of sterility; and therefore no apology was needed for discussing the subject in the Obstetrical and Gynæcological Section of the Royal Society of Medicine. They could do something else, which was by no means unimportant: they could recognize those cases in which sterility was inevitable and incurable. When it was quite certain that a woman could not bear children it was much better that she and her husband should know the truth and face the disappointment once for all. Not only were they saved the constantly recurring disappointment that marked each appearance of menstruation; they were also able to adjust their lives to the facts. He was persuaded that many a husband and wife, if they knew early in their married life that they could not expect to have a child of their own, would adopt one; and thus find at least a partial outlet for the expression of those instincts of fatherhood and motherhood, the unsatisfied repression of which marred the happiness of so many families.

In this communication he proposed to touch on two of the general aspects of the subject, viz.:—

(I) The prevalence of sterility.
(II) The responsibility of the male partner;

and then sketch out, as briefly and clearly as possible three types of sterility in women, viewed from the standpoint of prognosis and treatment, viz.:—

(III) Inevitable and incurable sterility.
(IV) Functional sterility.
(V) Conditions that caused or favoured sterility but allowed of treatment.

Data and statistics referred to were derived from his recent monograph[2] to which he need not make more particular reference. The references to authors quoted would be found there, unless otherwise specified.

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[1] At a meeting of the Section, held May 5, 1921.

[2] "Sterility in Women," by Arthur E. Giles, M.D., 1919; London: Henry Frowde, Hodder and Stoughton, Oxford University Press.

(I) *The Prevalence of Sterility.*

Estimates of the proportion of infertile marriages varied widely with different authors and in different countries. Some, like Frank and Burdach, placed it as low as 2 per cent., others as high as 20 per cent.

He had endeavoured to form an estimate from his case papers, with the following results: Among 3,128 married women who had been seen *as patients* the percentage of sterile cases was 22·2. Many of these, however, were still young and might yet conceive; when he took into consideration only women who had reached the age of 40, the percentage dropped to 15·3.

In a large proportion of cases the women had sought advice on account of some disease of the reproductive organs; comparing such a group of women with an equal number drawn from the community at large, it was certain that the number of sterile women in the latter group would be notably less.

It was, therefore, he thought, a sound deduction, that the proportion of sterile marriages in this country was well below 15 per cent. Dependence upon figures given by various writers was weakened by the fact that in some statistics stillbirths were taken into account, while in others they were not. Miscarriages and extra-uterine pregnancies were mostly overlooked or ignored. Yet it was obvious that a woman who had conceived was not sterile, even though the ultimate product of conception might not be a living child.

Of published estimates he was disposed to regard those of Simpson as being nearest to the truth; he had found the proportion of unfruitful marriages to be 10·9 per cent. in village communities and 16·3 per cent. in families of the aristocracy. The ratio was probably higher among dwellers in towns than among dwellers in the country.

In any case the proportion was undesirably and unnecessarily high. Compared with this certain fact, the actual figures were of only academic interest. If they wished to obtain a really reliable estimate of the number of unproductive marriages the only way would be to get the particulars of at least 1,000 marriages in which the wife was aged under 35 and the husband under 40 at the time of marriage, and married life had lasted at least fifteen years. But even these figures would not tell them the proportion of sterile *women* in the community, because in a number of cases the husband would be at fault.

(II) *The Responsibility of the Male Partner.*

This brought him to the second general question. It was not sufficiently realized that in many cases the woman was not at fault at all. Estimates again varied widely as to the proportion of cases in which the husband was to blame; Courty had placed it at 10 per cent., Duncan at 12 per cent., Brothers at 20 per cent. (based on 250 cases), Engelmann at 25 per cent., Hühner at 41 per cent. (186 cases), and Noeggerath at 90 per cent.

Noeggerath had been apparently obsessed by the idea that gonorrhœa was the one important factor in the causation of sterility; and both he and Engelmann included under man's responsibility all cases of disease in the female which were directly traceable to the male. It was no doubt morally justifiable to blame the man who had made his wife sterile by giving her gonorrhœa; but from the point of view of statistics it led to fallacious results. For while the woman whose tubes had been destroyed by gonorrhœa was permanently sterile, the man who had infected her might remain quite capable of procreating children.

But again, the actual figures did not greatly matter; what did matter was that they should appreciate the fact that in a childless marriage the woman might be not guilty, because it had an important practical corollary which was this: that in doubtful cases the wife should not be assumed to be responsible and submitted to operative procedures without obtaining definite evidence that the husband was healthy.

(III) *Inevitable and Incurable Sterility in Women.*

It would make it all the easier to recognize the cases of incurable sterility if they bore in mind the conditions necessary for successful impregnation. They were:—

(A) *On the Man's Part.*—Ability to deposit healthy seminal fluid in contact with the os externum cervicis.

(B) *On the Woman's Part.*—(1) Ability to receive this fluid in contact with the cervix.

(2) Such a healthy condition of uterus, tubes and ovaries as would enable the spermatozoa to travel up to meet the ovum.

(3) The production and discharge of healthy ova.

(4) Such a healthy condition of the uterus as would enable it to harbour the fertilized ovum.

They had to consider here only the woman's side of the question.

(1) Under the first heading the conditions that caused sterility were absence of the vagina and want of communication between the vagina and the uterus. When investigating a case it was not sufficient to accept a patient's statement that intercourse took place; that might be so, and yet they might find that the vagina ended blindly in a cul-de-sac. In such a case the woman had never menstruated, and this would at once put them on their guard against overlooking the condition. Three striking illustrative cases occurred to him, in which intercourse had been said to be normal and yet the vagina was closed above.

(*a*) *A case of androgyny, the patient living as a married woman.* This case was related in his monograph (Case 22, page 68).

(*b*) *A case of absence of the uterus with well-formed vagina, and double ovarian tumour.*[1]

(*c*) *A case of uterus bicornis with undeveloped cervix separated by connective tissue from a closed but fairly developed vagina.*[1]

Atresia of the vaginal orifice, such as occurred with retained menses, naturally prevented intercourse, but it did not come under the category that they were considering, because it was not incurable. It would be referred to again later.

When the lower end of the vagina was patent and the upper end was closed, it was not always possible to tell whether it was merely a case of a septum across an otherwise developed vagina, or whether the upper part of the vagina was absent. It might be necessary to undertake a dissection of the parts before this point could be cleared up. When the vagina was absent, the question might arise whether an artificial one should be made. From the point of view of their present subject, sterility, he would say that the procedure was likely to be quite hopeless. Whether it should be done in order to make married life possible was another matter. It was a very difficult thing to do, and in some cases repeated operations had been undertaken to make and maintain a patulous artificial vagina. Ingenuity, to his mind misplaced, had been exercised in the form of bringing down a portion of the colon for the purpose. If the tube, when made, did not lead to a uterus, what was the use of it all? Nature had at least provided another channel that could be used, if a perverted and unnatural sexual act was the only object.

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[1] Dr. Giles proposed shortly to report these two cases in full.

(2) The second condition for impregnation was such a healthy condition of the uterus, tubes and ovaries as would allow of the meeting of the spermatozoa with the ovum. This condition was unfulfilled in the case of absence or marked under-development of the uterus, congenital atresia of the tubes, and occlusion of the tubal channel by inflammation. Pyosalpinx, which was due to gonorrhœa in about 95 per cent. of cases and to tuberculosis or *Bacillus coli* infection in the remaining 5 per cent., certainly caused incurable sterility. Whether a tube that had become occluded by mild salpingitis could be made functionable by surgical means was a doubtful question, to which he would make further reference.

(3) They knew that for conception to be possible the ovary must produce healthy ova: but it was very difficult to say when it was not doing so. They knew that age and the action of X-rays led to ovarian atrophy; and they might presume that when this atrophy had come about ovulation ceased. But there were other conditions that apparently interfered with normal ovulation—for example, anæmia, chronic taking of drugs such as morphia, certain febrile conditions and some nerve conditions, including pituitary disease. Obesity might come into this category; certainly obesity and sterility were related; but whether obesity was the cause of the sterility, or whether they were both the results of some disturbed metabolic process, they did not know. Nor did they know what were the factors that disturbed normal ovulation or what was the influence, if any, of internal secretions on ovulation. If any product of internal secretion did play a part, they would expect that it was not the ovarian secretion, which was probably a product of ovulation rather than a causal factor in the process. It would not be unreasonable to assume that the physical and chemical causes of defective ovulation acted by interfering with the nutrition of the germ cells. Further researches on the internal secretions might shed some light on this very obscure and difficult subject.

(4) The fourth condition was not strictly one upon which successful impregnation depended, since failure therein led to miscarriage, not to sterility. But it was conveniently included here, because when patients consulted them they were not so much concerned in the possibilities of conception as in the chances of having a living child. From this point of view the cases that they must regard as hopeless and incurable were those of uterine tuberculosis, carcinoma and sarcoma of the body of the uterus and uterine fibrosis. In the last-named condition the absence of the mucosa rendered impossible what had been described as the "nidation of the ovum."

(IV) *Functional Sterility.*

When a childless woman who had been married for some years gave a history of regular menstruation without undue loss or unusual pain, and, on examination the pelvic organs appeared to be normal, they might regard the case as one of functional sterility. There were then several possibilities to be considered.

In the first place, complete intercourse might not have taken place, and this might have been due to impotence on the man's part or to nervousness and shyness on the woman's part; or because the first attempt had been painful the woman had been too fearful to try again, or the man had refrained lest he should seem unkind; or both young people had been obsessed with a morbid fear that a confinement would necessarily be fatal, such ideas being fostered by a certain type of sensational fiction in which the novelist always arranged for the heroine to die after an apparently natural childbirth. One patient, who had been married twenty-six years, had told him (Dr. Giles) that when she was married the period was on, and this seemed to have put her husband off, as she "had never had any provocation since." Secondly, it might be one of those cases in which the husband was at fault, suffering from azoöspermia or from a deficient vitality of spermatozoa, and this point might require investigation. Thirdly, it might be an instance of "sexual incompatability." They knew that there were cases in which a husband and wife had been unable to effect a conception together and yet each had been fertile with a different mate. The reason was not known and it was not even known whether the defect was psychological or physiological. There was certainly nothing that the medical attendant could do in the presence of this difficulty.

(V) *Conditions that caused or favoured Sterility but allowed of Treatment.*

They came now to the more hopeful side of their subject. It would be convenient to keep to the same classification as used before.

(1) *Conditions that prevented Normal Intercourse: (a) Atresia of the Vaginal Orifice.*—This was a curable condition; but the prognosis as regards sterility would depend on the stage at which treatment was undertaken. If menstruation had been going on for some time and its products accumulating in the closed vagina, secondary changes might be set up in the mucosa of the uterus, and later in the tubes, which might be inimical to conception. But if the patency of the vagina was established early, there was a good prospect of fertility.

(*b*) *Stenosis of the Vagina and Rigidity of the Hymen.*—Dilatation of the vaginal orifice under anæsthesia by means of the fingers or with graduated specula was often sufficient. In more pronounced cases of stenosis the vaginal wall should be incised vertically, and the resulting wound sewn up transversely. The prognosis was very good.

(*c*) *Dyspareunia and Vaginismus.*—The source of pain during intercourse should be sought; it was most frequently in the neighbourhood of the vaginal orifice and the remedy was usually simple. More deeply-seated pain might be due to a prolapsed ovary or some inflammatory condition of the appendages, and abdominal operation might be needed.

Inflammatory disease would, of course, require treatment on its own account, apart from the question of sterility; but a prolapsed ovary could be sutured up; and, if associated with retroversion, the fixing of the uterus in place was often sufficient to lift the ovary out of the painful zone.

Vaginismus was more difficult to treat; but even here a good dilatation of the vaginal orifice under anæsthesia would often help matters and the rest would depend mainly on the persuasive powers of a judicious husband. It was a condition in which suggestion might play a useful part.

Once the mechanical difficulty was overcome, the prognosis as regards sterility was good, as long as the patient had not waited until she was handicapped by the factor of age.

(*d*) *Tumours encroaching on the Vagina.*—An ovarian tumour or a uterine fibroid situated in the pelvis might cause a mechanical obstacle to intercourse. The treatment was of course surgical, and the prognosis would depend on the possibility of leaving at least one ovary and a not too much damaged uterus. The following case was worth mentioning:—

He had seen the patient, aged 36, when she had been married two months. She had sought advice on account of difficulty with intercourse; and on examination the vagina had been found encroached upon and apparently shortened by a large fibroid in the posterior wall of the uterus, pressing down the pouch of Douglas. He had done a myomectomy and hysteropexy; she had become pregnant three months later and had a normal confinement on the anniversary of her operation.

(*c*) *Prolapse and Procidentia.*—Since these conditions were usually the sequel of child-bearing, they were the cause of secondary rather than of primary sterility. The obstacle to intercourse was mechanical, and treatment allowed them to give a good prognosis. When pregnancy was greatly desired, he considered that operation was much better than pessary treatment; for pessary treatment was apt to defeat the object by the setting up of noxious discharges. He had many records of pregnancy and normal confinement following hysteropexy for prolapse and procidentia.

(2) *Conditions that allowed intercourse but interfered with the ascent of the Spermatozoa:* (*a*) *Under-development of the Uterus.*—In this condition the prognosis depended mainly on the patient's age: if she was not much over 20, it might be an instance of delayed rather than of arrested development. This was sufficiently rare to warrant the narration of an example:—

In the summer of 1911 he had seen a girl, aged 19; she had had amenorrhœa for a year and a half, and had previously menstruated slightly for a few months. Examination under anæsthesia had shown a distinctly under-developed uterus; it had felt small, and the sound had passed in 1¾ in. Dr. Giles had seen her again five years later; menstruation had been going on regularly for two years, the menstrual flow not very much, but lasting three to four days. She had been married six months. On examination, the uterus felt quite normal in size.

In quoting this case in his monograph Dr. Giles had added "I shall not be surprised if pregnancy occurs." This forecast had proved correct, and he had just heard that she was confined of a son the previous day.

Kisch had related a similar case.

Obviously one need not give a hopeless prognosis in such cases; but it must be borne in mind that most of the cases that they saw of under-development were really arrested development; and he knew of no treatment that would remedy the defect.

(*b*) *Anteflexion of the Uterus and Stenosis of the External Os.*—These conditions were frequently, but not necessarily, found together: and there was no doubt that the presence of either one or both of them must be regarded as very unfavourable to conception. But they could not say that conception was impossible. From the point of view of prognosis following treatment, these were among the most satisfactory cases met with; for if a proper dilatation of the cervical canal were carried out, and especially if this were followed by the insertion of an intra-uterine stem for a fortnight, the chances of subsequent pregnancy were very good. He had met with a number of instances of this.

(*c*) *Retroversion of the uterus* was another condition which must be considered as unfavourable to conception, but not as definitely preventing it. Retroversion of the gravid uterus was not rare, and there was no doubt that in many of the cases the displacement had preceded the pregnancy. On the other hand one met with a fair number of cases in which a patient who had had several years of sterile married life was found to be suffering from retroversion; and on correcting this, either with the help of pessaries or by operative means, pregnancy followed. A general rule as to whether surgical or other treatment should be adopted, could not be laid down, and it would take too long to discuss the matter then. Each case must be dealt with according to all the circumstances attending it.

(*d*) *Atresia of the Os Externum.*—Here prognosis was hopeless without treatment and not very good with it. As a rule such atresia was the result of inflammatory conditions, which were likely to have other bad effects on the uterus besides closing its orifice. Nevertheless, an attempt should be made to restore the patency of the canal.

(*e*) *Polypus in the Uterine Canal.*—Under this heading might be included fibroid and mucous polypi and submucous fibroid. In nearly every case the condition could be cured; the operation might be very simple, amounting to little more than a curetting, or it might be a big affair, namely an abdominal myomectomy by hysterotomy (i.e., the removal of a fibroid from inside the uterus by the abdominal route). Prognosis ranged from "very good" in the case of small polypi to "moderate" or even "bad" in the case of large intra-uterine fibroids.

(*f*) *Endometritis* caused, in some cases, absolute sterility by preventing conception; the *modus operandi* was probably the injurious effect of the discharge on the vitality of the spermatozoa. In other cases conception occurred, but the mucosa was not healthy enough to harbour the oösperm, and miscarriage followed. After treatment in the form of a careful curetting, the prognosis was good; and these cases formed a fair proportion of their successes in the treatment of sterility.

(*g*) *Salpingitis.*—It was nearly certain that in cases of mild salpingitis without occlusion of the tubal ostia, conception could take place; and in all probability the sequel was often a tubal pregnancy. It might be supposed, however, that uterine pregnancy also followed; for they were all familiar with cases in which childbed fever was apparently due to the lighting-up of a latent infection of the tubes. But such a condition could hardly be diagnosed before operation, and so the question of prognosis hardly came in.

There was another condition to be considered, namely *salpingitis with occlusion.* Obviously when this was present, conception was impossible; but within certain limits it could be remedied by operation, namely in those cases in which there had not been extensive suppuration or damage to the tubes. An artificial ostium could be made by making an incision in the tube, near the ovary, and oversewing the edges, to prevent the opening from closing up again.

A good deal of this conservative surgery had been done, and some successful cases had been reported, in which pregnancy had followed. He had done it himself in a few cases, but he had not heard of any of his patients having become pregnant. The prognosis should be very guarded; because although they might count upon restoring patency, they could not tell how far the damage to the tubal mucosa might vitiate the chances of pregnancy.

There were certain methods of treatment that had a place when the cause of sterility lay with the man; thus a vaso-vasostomy had been carried out when the vasa deferentia were occluded and there was evidence of live spermatozoa in the testicle; and in cases of male impotence, when the semen was normal, artificial insemination had been tried. He had not gone into these questions, as his observations were more particularly concerned with sterility in women.

He had endeavoured, in this short résumé, to outline the principles that would help them in giving a prognosis as to the prospects of childbearing, and the treatment that should be carried out in those cases in which a chance of improving those prospects was offered. In conclusion he would emphasize three points:—

(1) The possibility of the responsibity of the husband must always be borne in mind.

(2) It was unwise to promise a successful issue as the result of treatment; for though they might secure correct anatomical conditions, they could not control their physiological working.

(3) The idea that every sterile woman should be curetted ought to be discouraged. In fact, no operation on a woman should be undertaken unless they were reasonably satisfied that her husband was all right.

Dr. R. A. Gibbons

said that Dr. Giles stated that the percentage of sterility in women varied from 2 to 20, according to those who had collected the cases, and he had seen figures giving a percentage as high as 23. Those who had endeavoured to collect statistics regarding this knew how difficult it was to secure accuracy—for instance patients had told him (Dr. Gibbons) when consulting him about sterility that they had never taken any precautions against conception, and had subsequently confessed to having used them for many months after marriage. When Matthews Duncan and Simpson had collected cases, there was not the likelihood of error which now existed, because, in those days, preventives to conception had been practically unknown, therefore it was quite legitimate to take the figures in the Peerage. Now, however, so-called Malthusian methods, with their danger to the State, were so common that there was no accuracy obtainable in such a book.

Nowadays it was quite common for girls about to marry to consult their medical adviser as to how to prevent conception. This of course, had a most important bearing on the State, because fertility in women was the basis of the fecundity of the nation, of its growth, and of its importance in the world. The test of fertility was the rapidity with which women conceived, and it was known that the average fertility of fertile marriages during the whole of the child-bearing period in life was ten. Now it might surprise some to know that as a result of a voluntary confidential census among intellectuals, it had been found that of 120 marriages, 107 were "limited," and that the average number of children of each marriage was considerably under two.

According to the tables collected by Bertillon, the annual birth-rate per thousand had fallen in Paris gradually from 104 in very poor quarters of the city, to 34 in very rich quarters, and in London, under similar conditions, from 197 to 63 per thousand; that was to say that the "gospel of comfort" had prevailed.

It was said that the percentage of sterility was the index to the morals of the nation. They knew that congenital sterility was rare, both in men and women, but it looked as if they were becoming a decadent nation, for the number of children in each family had steadily declined in recent years. The births for England and Wales had been 22,417 fewer for the June quarter of last year (1920), than for the previous quarter. This decline could not be attributed to the postponement of marriage, to decrease in the number of marriages, or to diminished fertility. Dr. Desplats was of opinion that in a certain large city abroad one-third of the pregnancies were aborted, and they knew that Sir James Oliver had called attention to the danger of diachylon, which was well known to be used to procure abortion, especially in the north of England.

Now taking the foregoing with the statement of Douglas White that three times as many children died in the nine months before birth as died in the first two months after birth, and of Dr. Routh, that the still-birth rate was probably higher than 3 per cent. of total births, it showed what an enormous amount of loss to the State occurred. Many of these deaths were of course unavoidable, but he (Dr. Gibbons) thought it their duty to do everything in their power to remedy this and save life. In his opinion, it was of great importance that newly-married couples who sought advice should be told that they took precautions against conception at their own risk, and that they could not break physiological laws with impunity.

In the case of the rabbit, if the doe when ready, was withheld from the buck through several consecutive periods of œstrum, most of the follicles underwent degeneration, and frequently, during the remainder of the breeding season, and sometimes for future seasons, the female was sterile. Surely this should teach them a lesson!

He had had sufficient experience to say that he had known women who had started married life with a determination to avoid conception, who had years afterwards given up preventives, and had done everything in their power to cause conception, but had failed; and he had known women who, having had one child after marriage, had determined to have no more, who had subsequently changed their minds, and had been bitterly disappointed that all their efforts to procure a second child had had no result.

Now this had nothing to do with so-called "one-child sterility," which usually could be traced to some puerperal trouble of the uterus or tubes. In these women, he had been satisfied that pelvic examination revealed nothing abnormal and that the husbands were sexually sound.

He was certain that the majority of men did not know the harm which might follow the use of these preventives, especially to the nervous system of women who had normal sexual feelings, and he therefore considered it of the highest importance that they should be told.

Dr. Malcolm Donaldson

said he was most interested in cases of sterile women who proved normal on physical examination, and their husbands also, and wished Dr. Giles had spent more time on the discussion of these cases. Dr. Donaldson had examined nine women on twenty-two occasions to see how far up the canal spermatozoa could be traced, without getting conclusive results. Mr. Kenneth Walker had co-operated with him by examining the husbands. Dr. Donaldson asked Dr. Giles whether he considered that estimation of the acidity of the cervical discharge would be useful, and whether he had tried passing oxygen through the uterus to see whether the tubes were patent. He had thought that everyone nowadays examined the husband before submitting the wife to operation, but he had recently found aspermia in a husband whose wife had given a history of two curettings.

Mr. Kenneth Walker

said that as he had examined the husbands of the patients in the cases referred to by Dr. Donaldson he would state what he had found.

It was naturally a matter of great difficulty to determine the percentage of sterile marriages in which the man was responsible. Various statistics had been given ranging from from 45·4 per cent. (Sänger) to 18 per cent. (Gross). His own series of cases was too small to justify the formation of statistics, but he was convinced that sterility was commoner in males than had previously been recognized.

What was more interesting still was the large percentage of husbands who although not absolutely sterile might be regarded as relatively so. Whilst in something like 15 per cent. of cases one could dogmatically state that the husband was sterile, in a still larger number one could detect some abnormality in the genitalia; in other words, there was either oligospermia or what might be regarded as an undue number of degenerate forms of spermatozoa, or signs of inflammatory trouble in the testes, prostate or vesicles. The prostatic fluid in these cases contained pus cells and occasionally a considerable number of cholesterin crystals.

He was unaware of the extent of a gynæcologist's knowledge of the accessory sexual glands in the female, but the genito-urinary surgeon's knowledge of the male accessory glands was exceedingly sketchy. They did not know what were the functions of the vesicles or of the prostate. They did however know that the action of at any rate one of these glands was esssential to fertility. If the vesicles of a rat were removed he remained fertile; the same was true if the prostate were excised. If, however, the rat were deprived of both prostate and vesicles, he became sterile. Mr. Walker believed this to be confirmed by clinical experience. This being so, the mere presence of spermatozoa in the semen did not prove that the male was beyond suspicion. For this reason the usual cursory examination of a husband was quite inadequate if they were to be sure that the cause of sterility did not lie with him. Although the modern gynæcologist had recognized the importance of an examination of a husband before resorting to operative procedures in the wife, he (Mr. Walker) did not think that he had realized how thorough that examination should be. A much closer co-operation must exist between the gynæcologist and the genito-urinary surgeon if mistakes were not to be made, and it was on the necessity for this mutual co-operation that he would lay special stress.

Dr. HERBERT SPENCER

said that he was glad to find Dr. Giles condemning the making of an artificial vagina out of intestine in patients in whom the uterus and vagina were absent. In his opinion, ventrofixation for retroversion and prolapse of the ovary should also be expunged from the list of gynæcological operations, for, although it would keep the uterus in position, it was not free from risk either immediate or remote (dystocia and intestinal obstruction), and the replacement could be effected by simpler means (pessaries and shortening of the round ligaments). He had known many patients become pregnant after myomectomy. An interesting case was that of a large tumour attached to the whole of the back of the uterus, in which the patient had conceived shortly after the operation and had had a living child by Cæsarean section. Here the broad attachment had seemed to indicate hysterectomy, but the conservative operation had been done at the patient's urgent request with a happy result, and at the Cæsarean section the posterior surface of the uterus had been found quite free from adhesions and the site of the myomectomy only indicated by three white specks beneath the peritoneum. He had seen one case in which an undeveloped uterus, which had been dilated unsuccessfully, conceived at once, after seven years' sterile life, on Pozzi's operation being performed. He had formerly dilated a great many patients for sterility and had applied a stem for twelve hours in some of the cases. But the proportion of success had been so small that he had for nearly twenty years abandoned it in favour of Pozzi's operation, which gave much better results. When he had spoken in favour of Pozzi's operation in New York twelve years ago no one at the meeting had confessed to having performed the operation and one speaker had said that, in America, they were accustomed to stitch up split cervices, not to make them. The prolonged wearing of an intra-uterine stem had often been followed by inflammation ; no doubt the risk was less if the patient were kept in bed as in Dr. Giles's cases. There was one form of sterility which Dr. Giles had not mentioned, namely, that due to a small overgrowth of the mucous membrane at the external os, probably resulting from slight tears in a previous labour, forming a sort of ball-valve to the external os. He had known the simple removal of this small growth by a V-shaped incision to be followed by pregnancy in several instances. He had thought this was a discovery of his own till he had found that Marion Sims had described and figured it. In all cases of sterility it must be remembered that the patient might conceive without operation ; this he had known in one case after twenty-one years of sterile life; in another case a patient who had applied for treatment after several years of sterile married life had been actually pregnant at the time of consultation.

He could corroborate Dr. Gibbons' statement as to the frequent use of preventives and their effect in causing permanent sterility. In the case of quinine pessaries, especially, he had found a thickening of the epithelium of the external os which probably extended to the endometrium and explained the permanent sterility when patients who had used the pessaries in early married life had later left off their use in the hope of having a child.

Dr. Louise McIlroy

thought that Dr. Giles' interesting address might be continued on further lines —as to the question of the factors which influenced fertility. The causes of sterility, as far as pathological conditions were concerned, were pretty well known, but the work of the future must go upon physiological and biological lines, and the effect of the internal secretory organs upon the reproductive functions. The ovum should be looked upon as a temporary ductless gland, and in cases of repeated abortion where no cause could be found, there was sometimes evidence of the inhibitory action of the endocrines upon the growth of the ovum. It might perhaps follow that these same organs might inhibit fertilization or embedding of the ovum. Among cattle it was found that the massage of an ovary containing a persistent corpus luteum favoured fertilization in previously sterile animals. Dr. McIlroy thought that the Section should protest against the growing prevalency of use by women of contraconceptive pessaries, and that efforts to prevent the satisfaction of the maternal instinct when the sex instinct was stimulated at the same time, were no doubt accountable for many gynæcological conditions and neuroses.

Dr. Fairbairn

said he felt that the most difficult cases were chiefly those without physical signs or mechanical cause. He agreed with Professor Louise McIlroy that until bio-chemical research had supplied the necessary information, their efforts to cure sterility must largely be on the principle of working in the dark, once the causes had been investigated as far as was possible. A very interesting paper had been published by Professor Arthur Robinson, of Edinburgh, on "Pre-natal Death," in which he had used statistics from the Board of Agriculture with regard to the fertility of mares and stallions. He (Professor Robinson) called attention to the fact that in the case of Clydesdale stallions nearly half the matings were unfertile, and in thoroughbreds more than half, though both the male and female were presumably healthy. Other researches on ferrets, in which the females had been examined in various stages of pregnancy, showed that degenerative changes in some of the zygotes had taken place, whilst others in the same animal were perfectly healthy. All that pointed to factors governing both the sperm and germ cell and the zygote derived from them, of which at present there was no scientific knowledge.

Dr. GILES (in reply)

endorsed Dr. Gibbons' remarks as to the great unhappiness resulting from deliberately childless marriages, and said he had always warned patients of this. He believed that quinine had a permanently bad effect. Those who waited for a convenient season to have a child often laid up trouble for themselves. On the question of fibroids he had come to the conclusion that these were not a cause but in a sense a consequence of sterility. Women who were subjected to sexual excitement with no physiological outlet appeared to have a tendency to develop fibroids. He would like the opinion to go forth from the Section that the use of contraceptives was a bad thing. He agreed with Dr. Donaldson and Professor McIlroy that the apparently normal cases were the most difficult, but he had not said more on this subject because there was such profound ignorance concerning it. As to the reaction of the cervical secretion, the normal reaction was of course alkaline. After endometritis it might become acid, and spermatozoa could not live in an acid medium. He had not tried the injection of oxygen for diagnostic purposes. He was interested in Mr. Kenneth Walker's remarks as to the large percentage of defect traceable to the male partner. It must be borne in mind that the success of treatment was difficult to estimate, since in some cases after many years conception occurred spontaneously. He had heard of one case in which pregnancy was reported to have occurred after twenty years of sterility. Changes in habits were also a factor; too great frequency of intercourse might prevent conception, whereas rest and change often proved beneficial.

The June meeting of the Section of Obstetrics and Gynæcology was not held owing to the meeting of the British Congress of Gynæcology and Obstetrics at Birmingham, in which the Section took part.

A full report of that meeting will be found in the *British Journal of Obstetrics and Gynæcology*, and a good abstract in the *Lancet* and the *British Medical Journal*.

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

PRESIDENT'S ADDRESS:

The Importance of Clinical Observation in Dental Surgery.[1]

By W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.
(President).

The papers presented to this Section and to its forerunner, the Odontological Society of Great Britain, have seemed to me to deal too exclusively with problems requiring for their solution research, either in a laboratory or in a museum. Not one of these papers has been, in any sense, superfluous, but clinical observation acts as a corrective. Research depends so largely on the methods available that the conclusions drawn need constantly to be revised, when improved methods and apparatus are available. Clinical observation, on the other hand, records facts which, though they do need laboratory research for their elucidation, yet remain facts for all time. To these all theories must conform.

Clinical observation has other advantages: Every practitioner has in his daily work a field for study resembling a museum. His specimens are not dead, but living; altering from day to day; hence he can watch the beginnings, the growth, and the endings of disease. This being so it is regrettable that the result of clinical observations are not more frequently recorded. Even more regrettable that the advantage of keeping complete records does not appeal to us early in our career; or, as in my own case, that other interests are allowed to prevent it.

A few cases, coming under my observation, will illustrate my contention. The first case is that of a young girl, who, upon the one side of the maxilla, has a fully developed lateral incisor, but a skiagam shows the corresponding tooth upon the other side to be absent. I have seen other similar cases. Now it is thought that the teeth of man are undergoing regressive changes, more especially in civilized races than in more primitive types. It is suggested, also, that these changes may lead to the total disappearance of some teeth, especially of the third molars and of the lateral incisors. Further, some have associated the diminishing size of the jaws with this regressive change, as cause and effect. I do not wish to argue for or against this theory. I wish simply to put before you some clinical facts which seem to be out of harmony with it.

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[1] At a meeting of the Section, held October 25, 1920.

Take the third molars. We know these begin to develop at an early age long before they (if we can imagine them to be endowed with perceptive sense) can know whether there will be room for their development, or not. For I take it to be admitted that the growth of the mandible, for instance, is as dependent and consequent on its use as is that of any other bone in the body. The large mandibles observed among those who lead a laborious existence must be the result of their life history, or else there remains this idea—only those who are predestined to have large mandibles drift into such employment, and this seems absurd.

Now, frequently we see third molars present and endeavouring to erupt in ill-developed jaws and, per contra, absent when there is room for their development. Bolk draws attention to another curious anomaly in connexion with lower molars. It is admitted the lower third molars are absent frequently, but when present they show no sign of regressive change; whereas the lower second molars, which are absent rarely, have become reduced, usually, to four-cusped teeth, and, rarely, may have only three cusps. Bolk also records a case, somewhat parallel to the one I first mentioned, in which the lower third molar tooth was absent upon the one side but was present and normal in form upon the other.

Again, if lack of development of the bone be the determining factor, how are we to explain the absence of second premolars? For these, admittedly, there is abundance of space; indeed, our attention is usually drawn to the absence of the premolar by the persistence of a much larger tooth, the second deciduous molar. Moreover, if the relatively frequent absence of the second premolar be due to a regressive change how are we to account for the fact that the first premolar, rarely absent, shows most marked simplification?

There are, indeed, some reasons for thinking that, to take the lower second premolar, its common change is progressive in nature. Thus a large percentage of lower premolars are tri-tubercular, or, more correctly quinti-tubercular (fig. 1, C).

Jonge Cohen points out, correctly, that what may be regarded as the normal type is a sexi-tubercular tooth (fig. 1, E).

There are two main cusps, the buccal, or protomere, and the lingual, or deuteromere. Medial and distal to these are two subsidiary cusps. These may be represented by the formula $\frac{2}{4}\,\frac{\text{P}}{\text{D}}\,\frac{1}{3}$. Cohen regards a quinti-tubercular tooth as derived from the sexi-tubercular type by the suppression of the medial cusp, or three of the lingual series, and by progressive changes in the deuteromere and in the distal cusp, or four, so that these equal the buccal cusps in size and height. His chief reasons for this assumption are that quinti-tubercular premolars are often associated with progressive changes in other teeth, such as the development of the cingulum of the incisors; also, he states, that if more than one root be present the tooth is of this type. Having read Cohen's book only recently it would ill become me to question these statements, but I show a second premolar (fig. 1, A), extracted by me last week, which is undoubtedly sexi-tubercular and with it the two first premolars. The roots of these, though single, both show marked tendency towards division, indeed the apex of one is bifid (fig. 1, B). But whether these changes be progressive or not the result is a large,

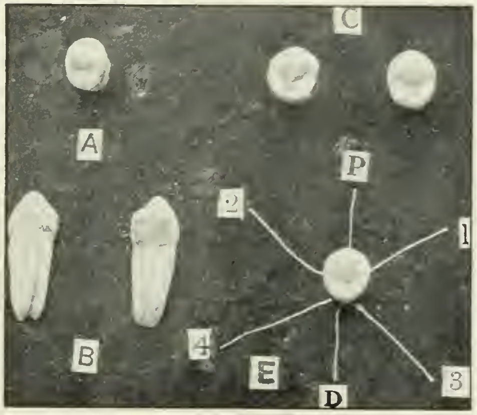

FIG. 1.

Second lower premolars: C, quinti-tubercular, right and left; E, sexi-tubercular; A, sexi-tubercular, second lower, and B, first lower premolars from same patient.

molariform type of tooth, which most certainly suggests no simplification nor regression of type, as a step towards its disappearance.

It is noteworthy, surely, that if the first premolar be formed on the same lines as the second, as we can hardly doubt, then it is also morphologically a sexi-tubercular tooth which has become simplified so that the lateral cusps are rarely seen. Yet this tooth is practically never absent.

Is the occasional absence of these lateral incisors intimately connected with a gradual diminution in the number of teeth? I should like to place on record that I have seen a larger number of patients, who, by the development of supernumerary teeth in the incisor regions, might be supposed to have an increased number of incisors, than I have of those in whom the number was diminished by the absence of the lateral incisors. I admit that one sees a considerable number of peg-shaped laterals, but these are too obvious to escape notice throughout the patient's life. From constantly seeing the same patient I fancy one is led to think the teeth are more frequently dwarfed or absent than they are; whilst, on the other hand, supernumerary teeth are usually extracted: their existence is forgotten and another observer does not know of their previous existence.

Supernumerary teeth in the incisor region well illustrate the necessity for deduction being corrected by wide clinical observation. In discussing the homology of incisor teeth, the argument is used that the second incisor of the full mammalian dentition is missing in primates, because in cases of cleft palate, which are relatively rare, a supernumerary tooth sometimes appears on the inner side of the cleft. Undoubtedly, in my experience, the appearance of a tooth in this position is far less common than that of a supernumerary tooth, or teeth, between the central incisors; a tooth, moreover, which erupts before the central incisors. If any argument with regard to the homology of the teeth can be based on the sporadic appearance of supernumerary teeth, which is surely doubtful, my experience suggests the missing teeth to be $\frac{I_1 \mid {}_1I}{\mid}$.

Whilst considering central incisor teeth I may call attention to the occasional formation of an excessive number of cusps which I do not recall having seen recorded. It is assumed generally, I think, that these teeth consist, like the premolars, of two three-cusped odontomeres. The lingual is not developed but simplified to form a single protuberance, but which, as an abnormality, may be developed in varying degree. The labial odontomere shows its tri-tubercular nature both by presenting three cusps, in an unworn tooth, and frequently by three elevations on the labial surface. A few years back I noticed an unworn central with four cusps, and my attention being directed to the point, I have found this form to be not uncommon, indeed five and even six can sometimes be distinguished. These, though distinctly marked, may be developed but slightly. Fig. 2 shows a cast of the best specimen I have seen, and with it a lateral incisor showing the same formation. Curiously, I have not noted the same condition in other lateral incisors, but have, very possibly, overlooked them.

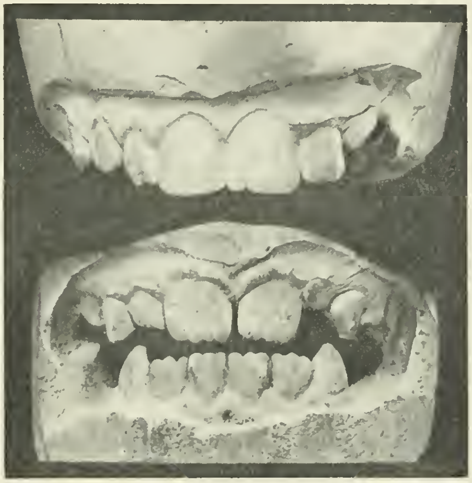

Fig. 2.

Lower model, upper central incisors with four cusps; upper model, lateral incisor with four cusps.

In connexion with the tri-tubercular nature of the labial odontomere, one may consider the absence of a tri-tubercular form in the incisors of congenital syphilitics. The coning of these commonly is considered to be due to the suppression, or regression, of the central denticle; as first, I think, suggested by Moon. This assumption may be correct, but I know of no evidence to support it. Indeed, the same effect would result from a uniform lack of development of the lateral denticles. Unworn, syphilitic incisors often show no cusps, central or lateral. It is indisputable that cone-shaped, notched incisors do occur in connexion with inherited syphilis, though the causation appears to be a mystery without analogy. But I do not consider the description of these teeth given in the text-books to be correct. I have seen quite a number of upper and lower incisors with the notch covered by apparently well-formed enamel. I possessed a pair of upper central incisors taken from the same patient which showed this distinctly; I am sorry they were lost or borrowed. But I am certain of my facts and, therefore, do not regard the notch as necessarily produced by the wearing away of a hypoplastic tip. Rather, I think that this hypoplasia, when it does occur, is not the direct result of the syphilis, but the result of an illness during the first months of life. Put in another way, syphilis does not directly cause hypoplasia, but leads to various dyscrasias which are the direct cause. Hence I suggest we have a conical tooth due to the syphilis, with a hypoplastic enamel tip due to the illness.

If there be no coincident illness of sufficient severity the enamel is normal in appearance but notched. To believe this notching is produced always by attrition surely requires the observer to show, from clinical observation, the presence of the abrading agent, which can and does produce the deformity. Clinical observation has not done this. I admit that such teeth may sometimes have diminutive cusps as described, though I have not seen them, because I suppose the statement to rest on clinical observation. But such cusps occur on teeth which are not syphilitic, and sometimes these are covered by what appears to be normal enamel. This can be seen in the two molars (fig. 3).

The possibility of the hypoplasia being associated with and due to illness of the mother cannot be wholly ignored. It is difficult to get evidence of this. Recently I saw a child with hypoplastic enamel on the extreme margins of the lower incisors, the rest of the enamel being normal. It appeared that the cause of this must have been prenatal. Inquiry elicited the fact that the mother died of consumption shortly after the child's birth. I think this was the cause of the hypoplasia. It is also possible that if a mother suffered from syphilis during pregnancy this might cause hypoplasia of the child's enamel, especially of the deciduous dentition.

Clinical observation discloses curious anomalies. I show a canine with a shortened root and a curious history. A boy was brought to me: he had an exceptionally good set of teeth, I may say a perfect set, save that the upper left canine had not erupted. But the lateral incisor and the first premolar were in apposition, giving an appearance quite the equal of that of the opposite side. I, therefore, determined to extract this canine, and I regret, that as the case seemed so clear, a skiagram was not taken. But because the extraction might prove difficult, if damage to the neighbouring teeth were to be avoided ; and because such injury would have been particularly unfortunate, as he was the son of an important Oriental personage, I had ether administered. This was fortunate, for the extraction proved extremely difficult, since the tooth proved, indisputably, to be lying horizontally with the apex of the root pointing in a labial direction. The tooth could not have taken this position after formation. The germ of the tooth must have been developed in this position. The lack of space, with possibly impeded and imperfect blood supply, must have caused the development of the stunted root. This shortening of the root has been a characteristic of the inverted teeth I have seen.

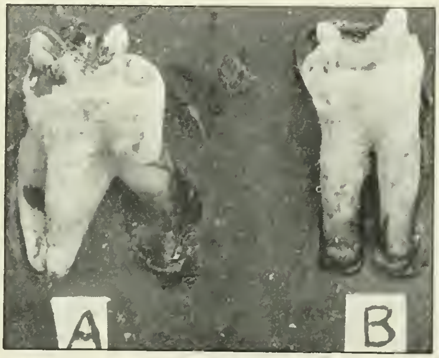

FIG. 3.

Upper and lower first molars with hypoplastic enamel but with cusps covered with normal enamel.

Radiography seems to have considerably altered our conception of the life history of teeth. It was assumed once that the displacement of a tooth was due to some disturbing cause during its eruption. Now a study of skiagrams enables it to be seen that teeth are developed in all sorts of positions, varying from slight to marked displacement from the normal. Some twenty, or more, years ago I showed a case of immediate torsion upon a central incisor, which had erupted with its cutting edge transverse to the arch. A skiagram showed the other non-erupted central to be in a similar position. A former President, who was also curator of our museum, the late Mr. Storer Bennett, regarded this as somewhat curious. I do not think he would do so now, because it seems to me evident that such malpositions are due to displacement, *ab initio*. This is well shown in the skiagram (fig. 4). Here the permanent canine can be seen erupting on the labial side of the first premolar. The deciduous canine is still in place, and the bone above it is empty, and available for the occupation of the permanent canine. It clearly shows that the persistence of the deciduous canine had nothing to do with the displacement of its successor.

Fig. 5 shows another unerupted canine. Above it is a clear space which it must have occupied at an earlier period. This was filled by a fleshy mass which I scraped out. According to Mr. Mummery's report, it consisted of connective tissue elements with no epithelial cells. The skiagram suggested it might be a cyst. The enamel on the tip of this tooth shows those curious markings, generally described as worm eaten. This tooth to my knowledge only slightly pierced the gum a little while before I removed it; consequently I think the markings must have existed before its eruption. I have seen like markings on the enamel of other unerupted teeth, but am unable to offer any explanation.

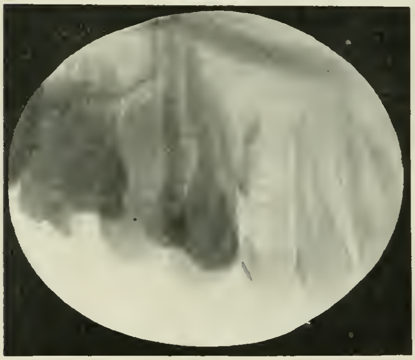

Fig. 4.

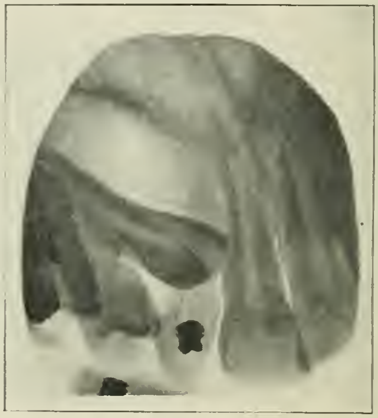

Fig. 5.

Fig. 4.—Upper canine erupting on the labial side of first premolar; deciduous canine in place, but its root shows some absorption.

Fig. 6 shows a series of third molars. The upper molars are joined by cementum to the second molars. The two illustrations show the position of the third molar may vary. The reason for this fusion is fully recognized from the fact that the crown of the third molar looks backwards while the tooth is developing, whilst its roots pass forwards and may touch and fuse with those of the second molar. In the mandible the position is the reverse. The crown looks forward. If, therefore, before eruption it approximates the second molar it determines absorption of the latter (fig. 6, E) and cannot fuse with it, unless periodontal inflammation lead to productive changes in the cementum, which then, possibly, may join together the roots of the teeth, as in those of the first and second premolar roots shown (fig. 6, C).

When two geminated teeth are found in the position of the lower third molar (fig. 6, D), the distal tooth is a supernumerary. At least it is so in the specimen shown, and so I have always believed. But skiagrams disclose most surprising things.

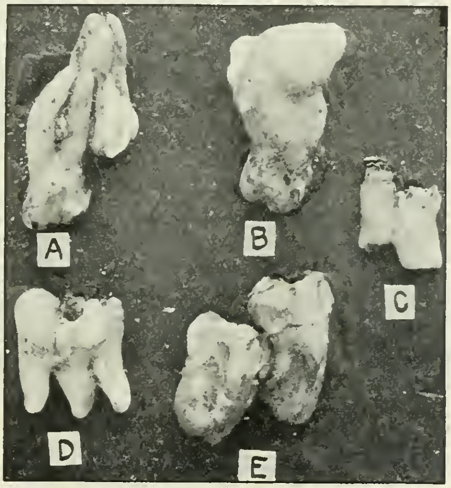

FIG. 6.

A and B, upper second molars, right and left, with third molars joined to their roots; C, premolar roots joined by cementum; D, lower third molar joined to a supernumerary molar; E, lower third molar causing absorption of distal surface of root of second molar.

The slide now shown (fig. 7) discloses an upper third molar with its crown directed forwards, and not backwards. The skiagram was taken to find the condition of the roots of teeth upon which bridges are fixed, and as far as that went showed them to be neither better nor worse than the uncrowned teeth. The presence of the third molar was entirely unsuspected, though the patient is over 60 years of age. It is rather difficult to account for the tooth being in this position. It must have been so developed and yet the roots appear to be of normal length, though it is difficult to understand where, so placed, was the space for this at the time of their development.

In view of this case it would seem impossible to deny that some lower third molars may, perhaps, develop with their crowns directed backwards, and that hence their roots may fuse with those of the second molars, even though one has not yet seen such a specimen.

The use of skiagrams is essential to full clinical investigation, but it is also essential that these shall be good. If indifferent and foggy, they must be very carefully examined and no variations of density ignored.

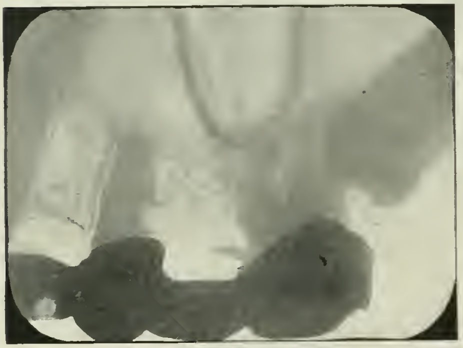

Fig. 7.

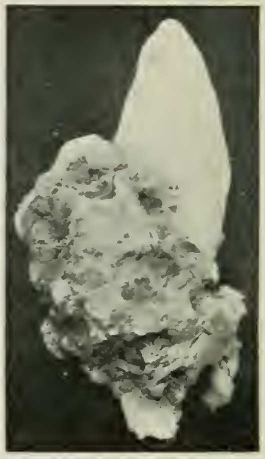

Fig. 8.

Fig. 7.—Third upper molar, unerupted, lying with its occlusal surface directed forwards.

Fig. 8.—Unerupted lower canine with root surrounded by necrosed bone.

The importance of this is illustrated by the following case: A man, about 50 years of age, was admitted to hospital with a swelling of the mandible, lingual and labial, on the right of the symphysis. The incisor teeth and the left canine were present, but the back teeth had been extracted. The teeth were septic, and I was asked to remove them before an exploratory operation. After the removal of these the tip of a hard body could be seen and felt on the lingual side and it moved on pressure. I, therefore, removed it and found it to be an unerupted canine with its root surrounded by necrosed bone (fig. 8). In the light of knowledge thus obtained, one then recognized in the skiagram a slight halo round a darker indistinct body. It seems extremely difficult to account for the necrosis of the bone around and closely adherent to an unerupted tooth. In default of any other cause one falls back on sepsis, but, at any rate, it remains a curiosity.

Another interesting case of necrosis occurred in a man, aged 45. Nine months before my seeing him a swelling appeared on one side of the mandible which, the patient said, came about once a month and went away again. Two months previously two decayed molars had been removed. I incised the swelling from the mouth, but though bare bone could be felt it did not appear to move (fig. 9). Two days after the sequestrum came away (fig. 10). The patient admitted having

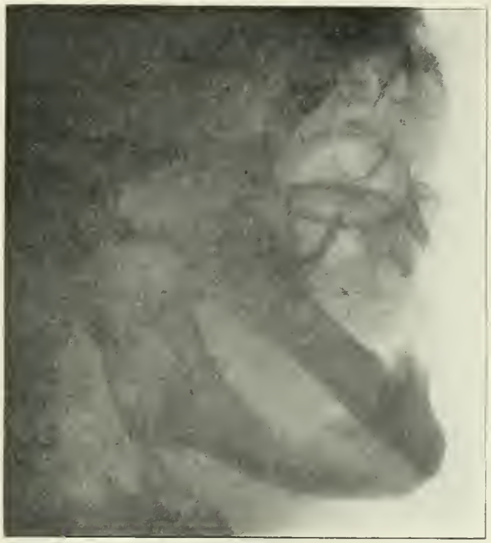

FIG. 9.

Sequestrum in situ in mandible.

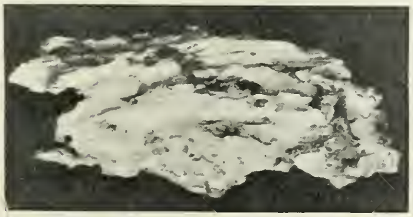

FIG. 10.

Sequestrum after separation. (Natural size.)

had syphilis long ago and Wassermann's reaction was positive. It would seem impossible to dissociate the syphilis and the necrosis, yet I cannot remember having seen another case of syphilitic necrosis of the mandible.

In a child necrosis as a sequel to the extraction of a tooth, because of a dental abscess, is not rare, but observation teaches the error of not closely following subsequent happenings. The skiagram (fig. 11) shows the mandible of a child. The space left by the separation of a sequestrum is clearly marked and further dead bone can be seen. It will be noticed, also, that the contraction of scar tissue has drawn the jaw across to that side and retracted it; thus her face was obviously deformed and her breathing impaired. This displacement could have been prevented by fitting a suitable appliance. This was not provided, with the following consequence. The child was emaciated and had difficulty in swallowing and in breathing. Her face was distorted. She was of a sensitive and lonely disposition. Hurt by the laughs and jeers of other children she hid herself in out-of-the-way corners of her poor home, a sad and pitiful little creature, because "someone had blundered." That "someone" was the person who could and might have fixed an appliance, but failed to see its need. The lesson is complete without the clinical history,

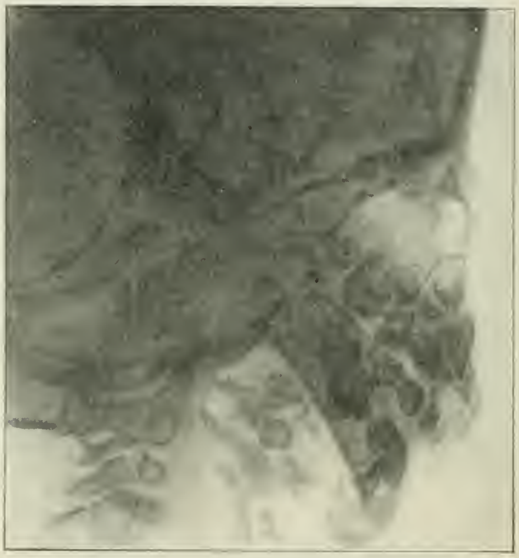

FIG. 11.

but I may add that when all the sequestra were removed only about a third of the right ascending ramus remained (fig. 12). A bone-graft was tried but failed. Possibly sufficient time was not allowed to lapse for the patient to be rid of latent sepsis. It was in the early days of the war before we had learned the lesson, but in any case there were technical difficulties on account of the smallness of her bones. The case appears to be typical of those occurring in civil life, which should benefit by the lessons taught by jaw surgery during the war.

The following two tumours are difficult to understand. The first occurred in a little girl about 12 years of age. In the region of the upper canine there was a smooth, fleshy growth reaching about half an inch below the gum margin and measuring about an inch in diameter. It had existed a long time. She said she remembered it when she was in an infant school. The skiagram (fig. 13) shows an appearance suggesting the presence of bony septa and, also, that the canine tooth is absent on this side, though present on the other. There is no history of extraction; indeed, at 12 years of age this appears improbable. A large portion of the growth was removed but it grew again. After more thorough removal it did not recur.

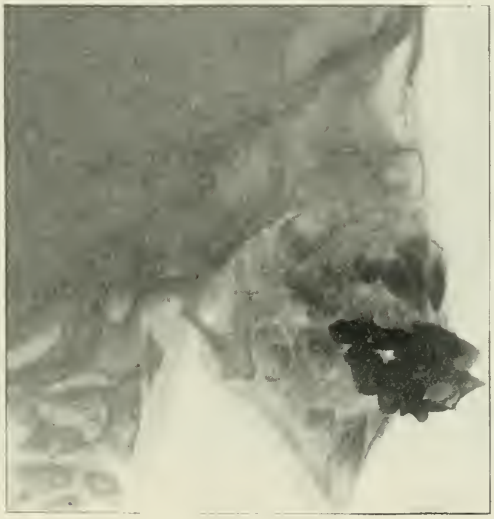

Fig. 12.

The microscopical examination showed connective tissue elements only (fig. 14) and no sign of epithelium. The piece removed at the second operation was also examined by Dr. Spilsbury who kindly reported: "The greater part of the section has a structure similar to that of the fragments examined previously. It consists of dense fibrous tissue with small fragments of bone included, apparently undergoing absorption. There is some superficial ulceration and the tissue in the base of the ulcer is chronic, inflammatory tissue undergoing organization and gradually merging into the dense, deeper tissue. The appearance in these sections is much more that of a chronic inflammatory process and there is nothing to suggest any form of new growth. There is no evidence of any special form of inflammation such as tuberculosis."

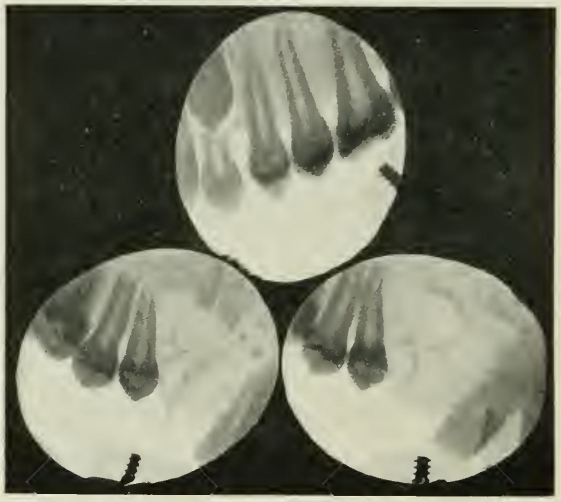

Fig. 13.

Lower skiagrams showing growth and absence of canine tooth. Upper skiagram showing permanent canine of opposite side, unerupted.

I quote this report in full, but the "ulcer" and the "chronic inflammatory tissue" were traumatic, the result of the first operation. The net result is this: Here was a growth of long duration consisting of dense fibrous tissue containing some bone, and the canine was absent, the latter a very rare event. Were these two things connected? I only record the facts, but wonder if this could be regarded as a form of fibrous odontome.

A second growth was seen in a man, of about 30 years of age, in 1915. There was a swelling in the premolar and molar region on the left side of the mandible. The skiagram (fig. 15) shows the appearance of a large cavity. I took it to be a cyst, but with fuller knowledge the somewhat irregular margin of the cavity can be appreciated and the faint markings suggestive of bony septa. The tumour was soft and on pressure there was a " give " without rebound, which I had previously noted in a case of a dental cyst. There was no sensation of crackling. In the angle of the opposite side of the mandible was a similar but smaller lesion. It is not well shown in the skiagram (fig. 16). Believing these to be cysts I attempted to open that on the left side. A piece of tissue was removed to a depth of about half an inch. It was firm and of a whitish colour. There was no cavity. Thinking it might be sarcomatous I asked Mr. Cope to see the patient. A week or so later he operated and removed more of the growth. Except for some inflammatory softening, due to my incisions, it was of the same character as that I removed.

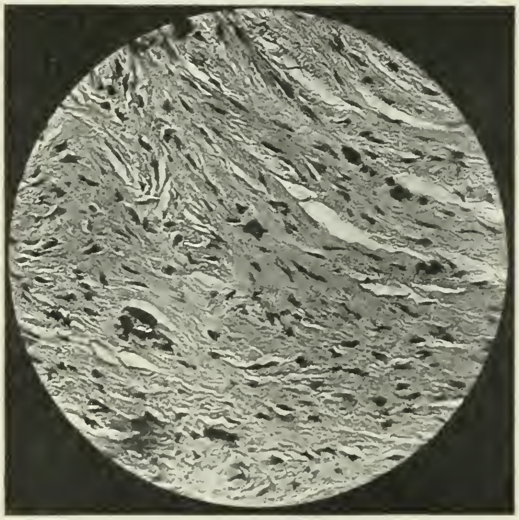

Fig. 14.

I have seen this patient from time to time. The skiagram taken in January, 1919 (fig. 17), three years later, shows that the growth on the left side had not enlarged, whilst the increase in the shadows within the area of the growth suggests the formation of new bone. The growth on the right side at the angle had considerably increased (fig. 18). The patient had suffered no discomfort.

In view of the pathological report, made at the time by Dr. Spilsbury, interference with the growth, on the right side more especially, did not seem urgent, as Mr. Cope was away on war service. I wrote recently asking the patient to come and see me. He has not done so yet.

I am able to show photomicrographs (figs. 19 and 20), kindly taken by Mr. Mummery from sections cut in the pathological department of

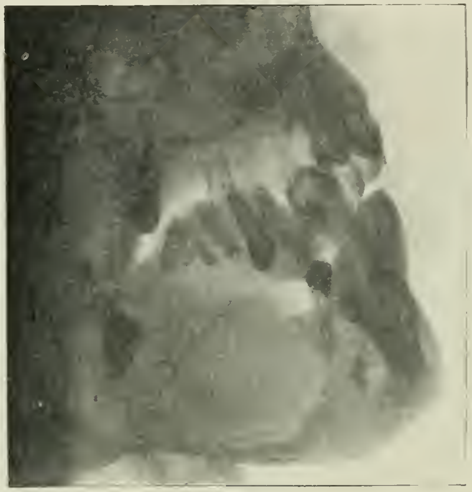

FIG. 15

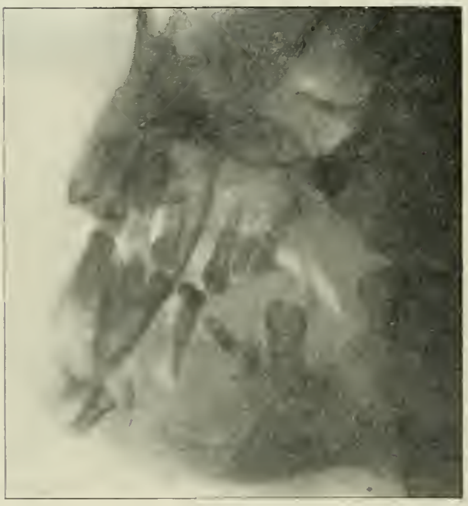

FIG. 16.

St. Mary's Hospital. On these sections Dr. Kettle was good enough to report: "The condition appears to be a chronic inflammatory process; there is no evidence of any new growth. It consists of dense fibrous tissue and the surface is ulcerated. Throughout the tissue there are a fair number of capillary vessels, and frequently these vessels are

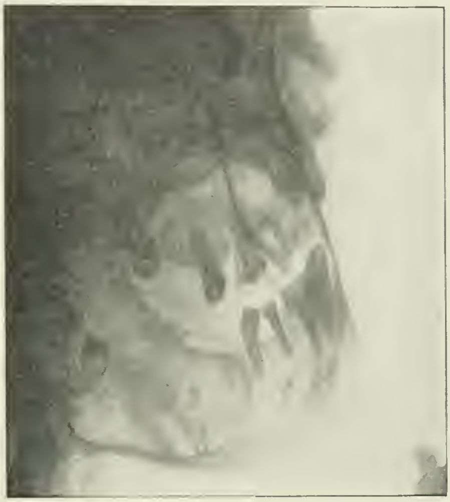

FIG. 17.

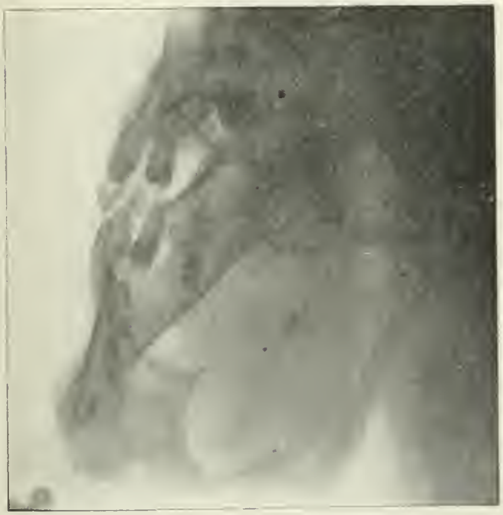

FIG. 18.

surrounded by a zone of round-celled infiltration. The most striking feature is the presence of large numbers of calcified bodies, varying greatly in size; their shape is sometimes irregular, but the majority of them are roughly spherical. They apparently represent deposits of calcium salts in a very chronic, inflammatory tissue, but the exact

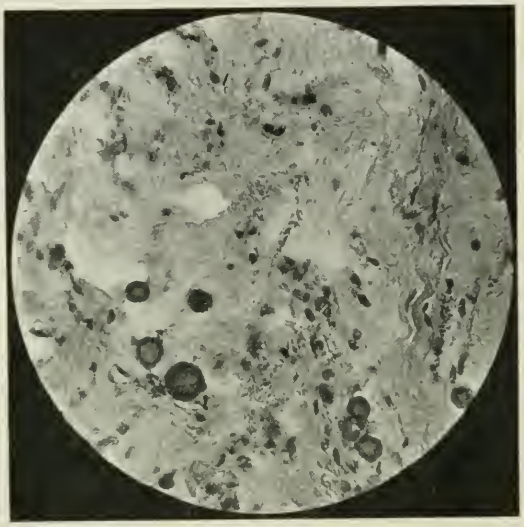

Fig. 19.

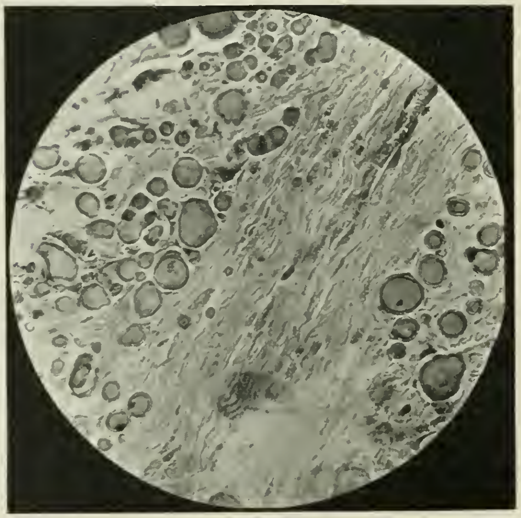

Fig. 20.

pathology of the condition is obscure." It is clear the surface ulceration was due to the first operation.

Of these calcified bodies Mr. Mummery says: "They are apparently hollow globes, although here and there some have become calcified right through and split up, in one corner of the section. The signet ring pattern occurs."

The pathological report does not help to explain the nature of the growth. The appearance of the right growth is in the skiagram so similar to that on the left side as to appear identical. That it is growing I have already noted.

A third tumour deserves mention on account of its rarity. Two symmetrical exostoses situated on the labial surface of the maxilla on either side of the frenum labii (fig. 21). The patient was a youth of about 21 years of age.

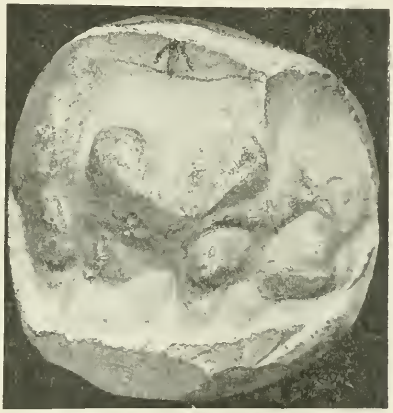

FIG. 21.

The teaching derivable from the cases mentioned is iconoclastic, as it tends to break down cherished theories. There are, however, clinical studies constructive in character, of which the following is an instance. Some may remember that before Miller published his classical experiments, I held the opinion that so-called "erosion of teeth" was abrasion by the tooth-brush and tooth-powder. His experiments confirmed my observations and converted opinion, and as illustrating the value of clinical observation, I now indicate the basis of my conclusion:—

First, the erosion was not caused by any secretion, acid or otherwise, of the gums. Because, if it were so, the cavities would extend to the gum margin, and usually they do not. There is a gingival margin of unaffected tooth substance.

Secondly, the erosion is not due to secretion, acid or otherwise, by glands of the lips or cheek. Because, if this were so, *a priori* the surfaces of the teeth most affected would be those in contact with the cheek—i.e., the buccal surfaces of the third molars, but these are never affected.

Thirdly, if erosion be due to the use of a tooth-brush and powder the cavities on the teeth of a right-handed person would be asymmetrical. On the right side the premolars would be most worn, whilst on the left side the teeth most cut into would be the incisors and the canine. This as a matter of fact is so.

Fourthly, if the patient be ambidextrous and uses the right hand for cleaning the right teeth and the left hand for cleaning the left teeth, then the cuttings will be symmetrical. A patient showing symmetrical markings explained, on inquiry, that this was how he cleaned his teeth.

Fifthly, if the markings be due to abrasion their development will vary with the character of the abrading agent and will, indeed, only commence when this is harmful. This is so. A patient, whom I attended from childhood, married, and shortly afterwards erosion cavities developed. Inquiry elicited the fact that she had adopted her husband's tooth-powder, and this on investigation proved to be of a peculiarly gritty character, and had worked havoc on her husband's teeth. That the deepening of the cavities ceased when an innocuous agent is used was shown, later, by the darkening of the floor of the cavities—the result of her smoking numerous cigarettes.

The following are a few notes on those irregularly shaped erosion cavities sometimes seen. There must be two factors in such phenomena. First, the abrading agent; secondly, the substance worn away. Rarely have we any previous knowledge of that which has gone, but we do know that the enamel of teeth varies in consistency. There are intermediate stages between normal enamel and that we regard as hypoplastic. Such a stage is the condition known as "white spots." These appear to be due to imperfect calcification. They may occur as bands across many teeth, or the incisive margins only may be affected, or there may be irregular patches on one tooth only. I have noticed that when these occur in one tooth only we may find a series of cases parallel to those in which the enamel of one tooth is hypoplastic. The deciduous predecessor may have been early extracted, and the common reason of this is an abscess. Or the root of the deciduous tooth may remain and be in process of exfoliation. I have seen two cases in which, as the result of an abscess under a deciduous molar, the crown of a premolar was cast off and lay between the exfoliating roots of the deciduous molar. Clinical facts therefore, teach us that disturbed nutrition whether general and due to illness, respiratory or alimentary in early life, or due to local inflammatory conditions, produces imperfect calcification of enamel, some patches softer than others being left. These soft patches must first be worn away and will leave cavities varying in shape with that of the patch.

The specimens shown (fig. 22) illustrate, first (C) an irregular cavity the result of abrasion. Secondly (B) a premolar with a chalky crown, the labial surface of which has a washed-away look quite unlike that usually seen in decay. Thirdly (A) a partly developed premolar accidentally extracted with its deciduous predecessor. It shows how closely the roots of the latter may grip the former and also, I think, how impeded the blood supply to the enamel organ must be, even normally, and still more so if the periodontal membrane of the deciduous tooth be inflamed.

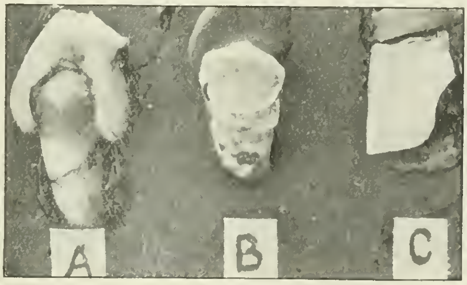

FIG. 22.

A, deciduous molar firmly grasping premolar; B, chalky patch on labial surface of premolar as seen shortly after eruption of tooth; root not fully formed; C, irregularly-shaped abrasion cavity on labial surface of central incisor.

This observation seems to indicate that whatever part disturbance of internal secretion, or the absence of food factors may play in the imperfect calcification of the dental tissues of the whole dentition, the same results can be seen to occur locally as a sequel to local inflammation.

Clinical observation to be of value must be complete or it may land us in trouble. During the war, in the absence of his regular medical attendant, a patient was sent to me by another practitioner for the treatment of oral sepsis. The teeth were extremely foul and, understanding the patient was considered to be suffering from some alimentary trouble, I advised their removal. This I did in a home under a general anæsthetic. Three or four days later an ulcer with a sloughing base formed on his palate, the cause or nature of which I confess I did not appreciate. About three months later the patient asked me to see him again. I found him, in another home, dying. The site of the ulcer was now a large perforation into his antrum. The cause of his trouble, of the ulcer and of his death, which followed soon, was tubercle.

About the same time I had another patient sent to me all of whose teeth had been extracted. In various places on his gums were little abscesses. A skiagram showed several small roots, broken fragments, which ordinarily would cause little or no trouble. These roots were difficult to locate. I removed most under a general anæsthetic but even a tiny fragment kept up the mischief till, later, I found it and removed it. That patient was also tubercular and these abscesses had reacted so that he was really ill, and not rendered any the more happy by various grave, but happily false, prognostications, including blindness.

One of the curiosities of clinical experience is that cases of like nature occur at the same time. I had an instance of this last Saturday. Two-rooted lower canines are not rare, but are not common. I have, perhaps, extracted about a dozen. In the course of extracting teeth for a patient the left lower canine proved to have two roots. Time was short but I managed also to extract the right canine; it had only one root. The first tooth I extracted for the next patient, quite in the ordinary course of work, was the right lower canine; it had two roots.

Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

Complete Absence of Deciduous and Permanent Teeth.[1]

By Montagu F. Hopson, L.D.S.E.

I am indebted to Mr. L. Messenier, a medical graduate of Calcutta now studying dental surgery in this country, for bringing this case to my notice.

The patient is a lad, aged 17, a Ghond—an aborigine of Central India—of the coolie class. The staple food of the Ghonds consists of unleavened wheat-cakes, pulse, and vegetables in small quantities when procurable. The district is within the famine area and Mr. Messenier states that the boy's physical condition was poor, he was tall, thin and emaciated and evidently suffering from malnutrition. But no apparent difficulty or inconvenience was experienced in dealing with such food as he could obtain.

It was impossible to secure radiograms, but the models speak for themselves. The mother confirmed the statement that no teeth had ever erupted. She and the other members of the family, so far as could be ascertained, had normal dentitions. There were no concomitant variations of the other dermal appendages. The maxilla is extremely flat; there is no alveolar ridge. Its extreme width is 45 mm. and it measures 40 mm. in its antero-posterior direction. The mandible is 55 mm. at its greatest width. The margins are very attenuated, presenting a knife-edged appearance.

I show you two photographs of the patient, one full-face and the other in profile; one would have expected to see a less well developed outline in the latter.

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[1] At a meeting of the Section, held November 22, 1920.

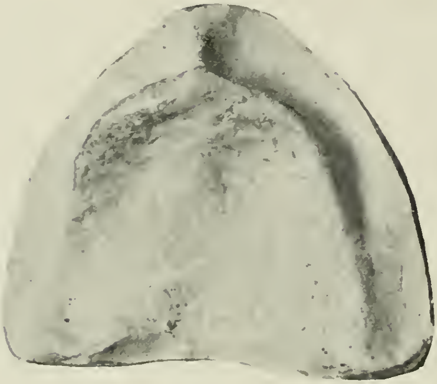

Fig. 1.

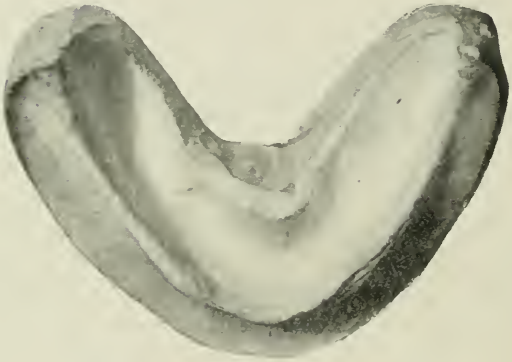

Fig. 2.

Twenty-one Unerupted Teeth in the Mouth of a Woman, aged 49.

By Montagu F. Hopson, L.D.S.E.

Patient, a female, a qualified pharmacist, aged 49, was born in Berkshire in 1871, and was breast-fed for the first month only; was very delicate during infancy and childhood, suffering from rickets and other ailments. She states, probably correctly, that her cranial sutures were not united until she attained womanhood. Her education was much interrupted and delayed owing to constant headaches.

The first deciduous tooth erupted at 14 months; the others appeared at long intervals over a long period. She shed two deciduous incisors when aged 11, and four or five others were extracted when she was aged 23.

In 1901 the remaining deciduous teeth were removed and seven fillings done, and that was when the patient first came under my notice. At that time the following permanent teeth were in place $\begin{array}{r|l} 8\,7\,6 & 6\,7 \\ \hline 7\,6\,5\,4 & \end{array}$; $\begin{array}{r|l} 7\,6 & 6 \\ \hline & \end{array}$ being hopelessly carious were removed.

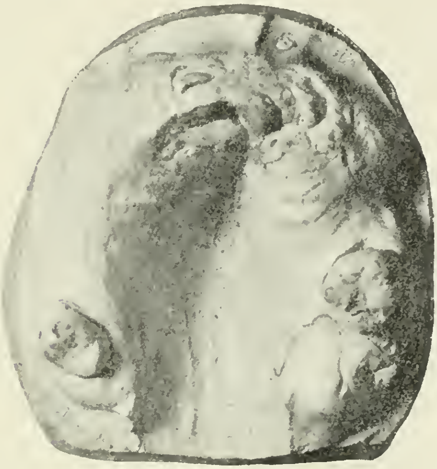

Fig. 1.

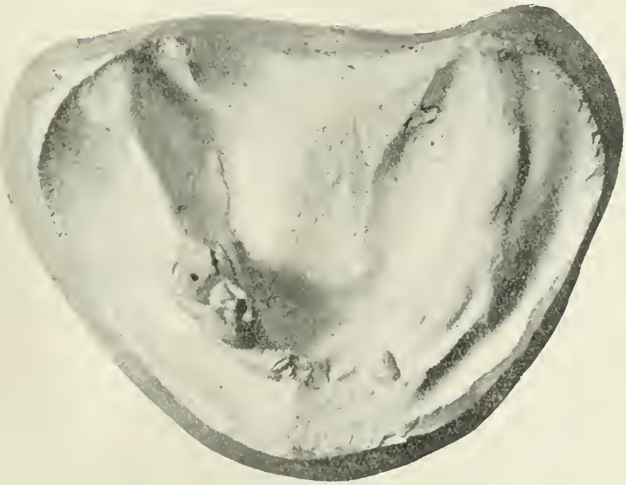

Fig. 2.

I next saw the patient in 1914. In the interval, $\begin{array}{r|l} & \\ \hline 7\;6 & \end{array}$ had been extracted, and $\begin{array}{r|l} & 8 \\ \hline & \end{array}$ had partially erupted. No other teeth were visible. I exhibit the radiograms taken at that time. They reveal the presence of the following unerupted teeth $\begin{array}{r|l} 8\quad 5\,4\,3\,2\,1 & 1\,2\,3\,4\,5 \\ \hline 8\qquad\quad 3\,2\,1 & 1\,2\,3\,4\,5 \end{array}$. They are lying in all sorts of positions and generally jumbled up together. There are two supernumerary teeth in the maxillary incisor region, but the three mandibular molars on the left are undeveloped.

Dentures were made, and these she has worn until the summer of the present year. Owing to the absorption and atrophy of the overlying tissues certain of the anterior teeth, both maxillary and mandibular, were showing through the gum. Eight of these I have removed under nasal-gas anæsthesia without any great difficulty. They were all more or less dwarfed in size, some having very stunted roots.

The patient has been radiographed with a view to determining whether there is any abnormality of the pituitary body. Those who have examined these radiograms are not in agreement; some regard the sella turcica as normal in size: others are inclined to think that there is evidence of maldevelopment of the anterior lobe of the gland.

It is interesting to compare the models of the mouth of the edentulous boy (p. 24) with those of this patient and to note the great difference in the form and character of the alveolar borders.

Case of Unerupted Teeth in a Woman aged 30.

By H. L. MESSENGER, M.C., L.R.C.P., M.R.C.S., L.D.S.E.

FAMILY history: A brother, aged 43, had persistent milk incisors, no permanent incisors having erupted. Two sisters are stated to have had many unerupted teeth.

Previous history: She stated that between the ages of 6 and 19 she did not lose any of her baby teeth nor did any permanent teeth erupt. At the age of 19 she had all her teeth removed on account of dental caries and full upper and lower dentures were subsequently fitted.

Present condition: I saw the patient in April, 1911, when she was 30 years of age, on account of the two upper central incisors which were erupting high up in the sulcus in a direction parallel with the floor of the nose. Otherwise there was nothing in the appearance of the jaws which would have led me to suppose that they were other than edentulous.

After X-ray photographs had been taken, these two incisors were removed without difficulty and a hypoplastic condition at the biting edge of each tooth was noticeable. The skiagram shows about twelve upper and eight lower unerupted teeth, all jumbled up and facing in many directions.

It was subsequently noted that the woman was of small stature, had no clavicles, and was weak in the knees.

Case showing the Backward Movement of the Lower Molars.

By J. G. Turner, F.R.C.S., L.D.S.

Some years ago I read a paper at an international medical congress at Buda-Pesth on the movements of teeth sequent to extraction. I showed that after extraction of a more anterior tooth a lower molar tilted forward but did not move bodily forward as in the case of the upper molars, and that after extraction of a lower first permanent molar the lower bicuspids and canines moved bodily backwards, more especially the second bicuspid. I showed also that both the tilting and the movement ceased *in toto* with the cessation of bone growth. The developmental relation of the lower first, second or third permanent molar to its anterior erupted neighbour suggests that a backward movement is needed to free the tooth and that when free from a posterior neighbour a lower molar would have a backward movement. I have long been looking for a case of early extraction of a second lower permanent molar to test this point.

The case I am bringing forward to-night, however, is not one of extraction, but of congenital absence of the left lower second permanent molar and of the right lower third permanent molar, and apparently of both upper third permanent molars. It seems to show that on the left side, in the absence of the second permanent molar the first permanent molar has moved bodily back at least ¼ in.; while on the right side, in the absence of the third permanent molar, the first and second permanent molars have moved back ⅛ in.

The patient is a well-grown girl, aged 13½. There is protrusion of the four upper incisors due to thumb-sucking, otherwise the profile is good; no adenoids nor enlarged tonsils. The upper incisors are spaced but behind this all the teeth are in good contact. The centre lines of both jaws coincide. The bite shows, on the left side, that the lower molar is at least ¼ in. post-normal, the bicuspids one bicuspid-width post-normal, and the canine rather less so. All the teeth of the left side are spaced and the X-ray picture shows the forming third molar well spaced from the first permanent molar. On the right side the bite of the molars is at the posterior limit of normal variation or just behind it, the proximal surfaces of upper and lower molars in occlusion being almost flush, the bicuspids are half a bicuspid-width back (the twisting of the first bicuspid making it appear farther back than it really is) ; the canine is about the same distance back. There is spacing back to the first bicuspid, but beyond this the teeth are in contact. The X-ray picture shows absence of third permanent molar and a fully formed second permanent molar.

I can suggest no explanation of this asymmetrical backward position of the lower teeth except that it is due to an inherent tendency of the lower molars during the growing period to move backwards. They are normally restrained by the presence of the posterior teeth or by lack of room. In this case the anterior molars have moved back in absence of posterior teeth and have been followed, as after extraction of a first permanent molar, by the bicuspids and canines. The spacing shows that there is no question of transmitted pressure of lips and cheeks, and the shapes of the molar teeth show that no action of inclined planes is capable of explaining the backward position of the lower molars. It is just possible that some unremembered mouth-breathing may account for part of the post-normal occlusion, but quite impossible that the more backward position of the left teeth can be so explained since the centre-lines of the jaws coincide. To my mind there is only one explanation—that it is due to a continuance of the normal backward movement of the lower molars which comes into play in eruption.

Some Cases of Hypoplasia of the Deciduous Dentition.

By A. T. Pitts, D.S.O., M.R.C.S., L.R.C.P., L.D.S.E.

Hypoplasia of the deciduous teeth, although recognized, is a rare condition. So far it has not received much recognition in this country, and specimens of it are not abundant in our museums. In Bennett's "System of Dental Surgery" the condition is only mentioned as occurring in the rare condition of hereditary hypoplasia. In Colyer's "Dental Surgery and Pathology" there is only a brief allusion to it. These cases were collected in the dental department of the Hospital for Sick Children. I first began to be interested in the subject before the war, when I was clinical assistant to Mr. James at that hospital. Up to that time I had never seen any cases. I began to note all cases which occurred, and when possible to preserve all specimens extracted. The war made a big interruption in this work, and many of the notes have been lost, but fortunately the specimens survived, and I have recently been going through them and sorting them out. A close scrutiny of my specimens shows that many of them were only doubtfully hypoplastic, and it might be argued with equal force that they were only examples of arrested caries, and that if they were hypoplastic on eruption the condition has been so masked by the later destruction of the teeth by caries as to render a certain diagnosis of hypoplasia impossible. Some cases remained which were unmistakable, and these I am showing to-night. These cases, fifteen in number, represent the total number found in at least 4,000 cases. Some cases may have eluded the notice of my fellow worker and myself at Great Ormond Street, but not many, since we were all on the look out for cases, and since the war I still note and collect all cases that occur. Some years ago, Mr. Sidney Spokes, in a paper on "Hypoplasia," estimated the percentage of cases occurring in the deciduous dentition at 2 per cent. My own figures fall far short of this. At the same time I doubt if my figures represent the true frequency. It is only possible to determine the existence of hypoplasia in a tooth if it is free, or relatively free from caries. We may suspect an antecedent condition of hypoplasia in many teeth, especially those with arrested caries, but it is impossible to prove. To determine the true percentage of hypoplasia in the deciduous teeth, it would be necessary to base our figures on the number of children in whom the deciduous teeth were present and comparatively free from caries. Even so, I think that the estimate of 2 per cent. is too high, and I should question whether it occurs in more than 1 per cent. at the outside, though I admit that this is only a surmise on my part.

Teeth Affected.—The teeth commonly affected are the molars, and then the canines; it is possible, however, that the marked attrition which occurs in the canine may sometimes obliterate the hypoplastic area. Hypoplasia of the incisors is extremely rare, and I have only seen it in two cases. In one the maxillary central incisors were affected, and this specimen I am able to show you. In the second case, occurring in a child aged 2, the lower first deciduous molars were affected, and also the lower incisors. The molars I extracted, and the specimens are shown, but the incisors were sound, and I left them. The immunity of the incisors from hypoplasia is, I think, not far to seek. Calcification of these teeth commences about the sixteenth week of intra-uterine life. Any condition so severe that it could affect the calcification of the enamel would very probably cause the death of the fœtus.

Character of the Enamel in Hypoplastic Teeth.—Speaking generally the hypoplasia in the deciduous teeth is less marked than in the permanent teeth. In the permanent molars the minimal type of hypoplasia seen affects the cusps alone, and from thence progresses towards the neck. In the deciduous molars the minimal type of hypoplasia consists of a fine stippled erosion of the enamel on the buccal or labial surfaces near to the neck. This variety is easily overlooked. At first I thought it might be due to caries, but I have seen it in cases where the teeth were not carious, or only slightly so. Furthermore, the buccal and lingual surfaces of the molars are not common sites for primary caries; if they are involved it is secondary to caries commencing interstitially or coronally. One of my specimens shows this type unusually well marked. It gives the teeth the appearance of being covered with a rough, pitted skin of enamel. In cases in which the hypoplasia is more severe the cusps are usually affected, and there is a definite diminution in their size. In the canines the hypoplasia usually shows itself in the form of narrow bands running transversely across the crowns.

Causes.—The causes of hypoplasia of the deciduous teeth are both ante-natal and post-natal. Calcification of the deciduous teeth commences at the sixteenth week, and according to Tomes, the following degree of calcification of the deciduous teeth is reached at birth. A full half of the crowns of the first incisors, about half that of the second, and the tip only of the canine are calcified; the first molars are complete as to their masticating surfaces; the second molars have their cusps more or less irregularly united. Broomell, in the *Dental Cosmos* for 1913,[1] figures some dissections of the jaws about birth or soon after, which show that calcification has advanced to a considerably greater degree. Dates and degrees of calcification must of necessity be approximate only, but it is quite certain that the enamel of the deciduous teeth is not completed till after birth. Whatever be the conditions which cause hypoplasia they thus operate in the later stages of pregnancy and during the first few months after birth. With regard to the ante-natal conditions, undoubtedly the most important disease affecting the fœtus is syphilis. There are other diseases, both hereditary and acquired, which affect the fœtus before birth, but they are rare in comparison with syphilis. Degrees of malnutrition short of definite disease may possibly cause hypoplasia, just as we believe they do in the permanent dentition. It must be remembered, however, that the fœtus can lay first claim on the maternal resources, and that slight degrees of malnutrition in the mother may not be reflected in the child. It is a very remarkable thing that in spite of the fact that so many mothers live under conditions adverse to health, that the majority of babies are born healthy.

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[1] *Dental Cosmos*, 1913, lv, pp. 740-42.

With regard to the post-natal condition, the child is then an independent organism and varying degrees of malnutrition occurring soon after birth may probably play a part in causing hypoplasia of the deciduous teeth. Rickets usually occurs too late to effect the deciduous teeth, but most of the diseases of childhood can occur sufficiently early to cause hypoplasia. It is evident, when we remember the stage of calcification reached at birth, that conditions occurring after birth will cause a less degree of hypoplasia than those occurring before birth. The patches of eroded enamel near the necks of the molars, which I described earlier, and the hypoplastic canines of which I show some specimens, are caused in this way.

Cavallaro, in the *Dental Cosmos* for 1907 and 1908, described very fully the dental stigmata of syphilis. He describes hypoplasia of the deciduous teeth as frequently occurring, and in fact regards it when present as pathognomonic of congenital syphilis, as much so as the notched permanent incisor. He goes further and regards lateness of eruption, spacing of the teeth, undue retention of the deciduous teeth, as all being signs of syphilis. I think that he casts his net far too wide and overstates his case. Nevertheless, I think that we must regard syphilis as an important factor in producing hypoplasia of the deciduous teeth, particularly where it is extensive, and that such a case should suggest the advisability of further inquiries along that line. In this connexion three of my cases are of interest as occurring in congenital syphilitics and in all of them the hypoplasia is extremely well marked. The first case is of especial interest, with a history of "snuffles" and a rash appearing on the genitalia soon after birth. The child was illegitimate and there was a history of several diseases in one of the parents. The Wassermann reaction was negative. The first permanent molars on the left were extracted and these conform to the type of molar described by Moon, which so frequently accompanies the Hutchinsonian incisors and is almost as typical as those teeth. A model of the upper jaw also shows the central incisors with a distinct tendency to a barrel shape and with a crescentic area of hypoplastic enamel on the cutting edge. In the second case the chain of evidence is not so complete, but the diagnosis of congenital syphilis was quite certain. Cavallaro and Parrot describe the Hutchinsonian incisor as occurring in the deciduous dentition. I have never seen a case, and I am doubtful if it occurs. I show here, however, a pair of maxillary incisors with well-marked notching. It is evidently caused by caries, but it is quite possible that some such teeth as these have been mistaken for the Hutchinson type of tooth.

So far, I have described the generalized form of hypoplasia, due to some cause affecting all the teeth which are being calcified during its period of operation, so that the markings are on different levels in the various teeth affected according to their stage of development. There is another form of hypoplasia: the local type. It is seen typically in the premolars. Mr. J. G. Turner has described the condition, and showed that it is due to an infection from the deciduous predecessor. I have here two specimens which I believe show this form in the deciduous tooth.

The first specimen is a right upper second deciduous molar. It had remained imperfectly erupted, so that it was not in occlusion with the opposing tooth in the lower jaw. All the other deciduous teeth were quite normal. It is definitely hypoplastic, and the crown is curiously dwarfed and cone-shaped. It is a pre-war specimen, and unfortunately I cannot give any further history.

The second case is a left upper first molar. The mother stated that at three weeks from birth she noticed a swelling in the child's upper jaw on the left. There was a sinus on the gum which discharged pus. The swelling subsided, but reappeared at intervals. The molar commenced to erupt at 6 months. When I saw the child he was 11 months old. The teeth present were $\begin{array}{r|l} a & a\ b\ \ d \\ \hline & \end{array}$. Only a part of the crown of the $\begin{array}{r|l} & \ \ d \\ \hline & \end{array}$ had erupted, and appeared to be badly formed. There was then no swelling. A rough model shows the upper jaw. I removed the tooth, which had a live pulp. As you will see, the tooth is hypoplastic. The antero-buccal part of the crown is affected, and I think there can be no doubt that this is a true case of local hypoplasia in the deciduous dentition caused by an infection acting on this particular tooth during its calcification.

Absence of the Permanent Teeth with Normal Absorption of their Deciduous Predecessors.

By A. T. Pitts, D.S.O., L.R.C.P., M.R.C.S., L.D.S.E.

The first case is that of a girl, aged 13, who came to the Royal Dental Hospital. The deciduous molars in the maxilla and the left side of the mandible were absent. Before treatment for crowding was decided on, X-rays were taken which showed that the premolars in the maxilla and the left side of the mandible were absent. On the right side of the mandible the first premolar had erupted and the second premolar was present in the jaw. On questioning the mother she informed me that the deciduous molars were removed by her; she described them as merely "on the gum," and she picked them out with her fingers. Further, she stated that they consisted of crowns only with no signs of roots. She was an intelligent woman, and I think we can take it that normal absorption of these teeth had occurred. As you will see the X-rays show an entire absence of the maxillary and left mandibular premolars.

The second case occurred in the practice of Mr. Guanziroli, who sent the teeth concerned and the X-rays to the Royal Dental Hospital museum, and has kindly allowed me to refer to them. In this case normal absorption of the deciduous maxillary lateral incisor and canine had occurred. The X-ray shows an absence of the permanent lateral and canine. Without a full-sized plate we cannot be sure that the permanent canine is absent for that is an extremely rare abnormality; but, it is not present in any position in which it could influence the absorption of its deciduous predecessor.

We are accustomed to think of the absorption of the deciduous teeth as being due to the developing permanent teeth underneath, and, in the majority of cases, the relation of the two would seem to warrant that assumption. In these two cases the absorption cannot be accounted for in this fashion. The whole mechanism of bone absorption is still very much of a mystery, and recently doubts have been cast on the osteoclast as a bone-absorbing cell. I am not prepared to offer any explanation of these cases, but simply bring them before you as two cases which seem to upset the current accepted theory of absorption of the deciduous teeth.

An Unusual Accident in Dental Practice.

By A. T. Pitts, D.S.O., L.R.C.P., M.R.C.S., L.D.S.E.

I have ventured to record the following recent incident in my practice, partly because it is rare and partly because I think it is well to place on record the various misadventures which occur in private practice so that they may serve as a warning. Recent events have impressed on us the fact that an unwelcome publicity may attend even the most inevitable of accidents.

The patient was a medical man. I was stopping a maxillary tooth and was using a saliva injector. He had an abundant flow of saliva and the tube was working vigorously. From time to time the rubber tube would collapse owing to the mucous membrane in the floor of the mouth occluding the opening of the glass tube. This was relieved by lifting the tube. Whilst I was busy stopping the tooth and not noticing the ejector, I suddenly missed the familiar gurgling noise and found the rubber tube collapsed. On trying to lift up the glass tube I found it was attached to the floor of the mouth, and that any attempt to move it caused the patient pain. Examination showed that the papilla of Wharton's duct on the left side had been drawn into the tube which, acting as a cupping glass, had caused venous congestion of the papilla. It was purple in colour and had swollen to about the size of a currant, completely filling the lumen of the tube. I cut off the suction, but it was quite impossible to reduce the swelling, and the only way to release the tissue was to break off the end of the tube. This was not very easy, as manipulation caused pain and the patient was unable to swallow. Finally, by introducing a stout probe into one of the free holes at the end of the tube and levering it sideways I was able to break off the end of the tube. I was then left with a saucer-shaped piece of glass lying in the floor of the mouth through a hole in which the narrow pedicle of the swelling passed. This I nibbled away with forceps until I was able to free the papilla. There was no bleeding, but some soreness and the presence of a mass of tissue under the tongue caused a good deal of inconvenience. The swelling slowly subsided, and a week later the papilla was normal in shape and colour, though still a little larger than the papilla on the opposite side. My patient took the incident very philosophically and was, in fact, rather interested in it from the medical point of view, but I could not help reflecting that with a nervous and excitable patient it might have been very difficult to free the engorged papilla. Also, that had I been using a metal tube it would probably have necessitated cutting off the mass of tissue, which, though not serious, would have left a sore mouth, occasioned some hæmorrhage, and perhaps led to some sloughing of the floor of the mouth.

The Acid Reaction of Certain Materials used in Filling Teeth.

By F. N. Doubleday, L.R.C.P., M.R.C.S., L.D.S.E.

Some two years ago I commenced a series of experiments to endeavour to find out if the silicate cement fillings in common use in dental practice destroyed the pulps of teeth, and if they did so what was the cause. I came to the conclusion[1] that pulps were killed by these fillings and that this happened owing to the persistence of an acid reaction for a considerable length of time. Zinc salts are chemically active; the aluminium salts, which are largely present in the silicate fillings, are chemically inert and incompletely eliminate the acid substances in the liquid. The experiments were commenced by my nurse having instructions to roll the residue of all the cement fillings we made into a strip of blue litmus paper; these showed a uniformly acid reaction which was well marked. Next we used test tubes each containing 5 c.c. of distilled water to which were added three drops of deci-normal alkaline litmus. It is some of these experiments which you now see. One of them is used as a control, to the second is added a pellet of a translucent cement kindly mixed for me about an hour ago by a member of the Section; you see that it instantly turns the litmus solution pink showing a well marked degree of acidity. Into other tubes are now dropped pellets of filling material, prepared by different dental surgeons, over periods of time up to fifteen months ago. In those which have been made up for some time the acid reaction develops more slowly and is less strongly marked. These experiments do bear out the fact that an acid reaction persists in many of these filling materials for some months. I am now trying to find out the relative acidity, and the length of persistence of the acid reaction of different varieties of compounds which come within the term translucent, or silicate, fillings.

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[1] F. N. Doubleday, "The Translucent Cement Filling," *Dental Record*, September, 1920.

This note is published to elicit comment upon the line of experiment which is being followed. Some helpful criticisms and suggestions have already been made to me and I shall be very glad of any others.

An Artificial Velum for Congenital Cleft Palate.

By J. Lewin Payne, L.R.C.P., M.R.C.S., L.D.S.

The modification of Kingsley's velum which I bring before you this evening is a very simple one. It is a method which may have been adopted by others who treat such cases by means of prosthetic appliances, but, simple though it is, I have not seen it described elsewhere. Cases of congenital cleft palate which call for mechanical treatment require very careful handling, and any method which renders the fitting of the appliance either less troublesome for the patient, or less difficult to the dental surgeon, is worthy of consideration, provided that an efficient result can be obtained.

Dr. Norman Kingsley's device, I may remind you, was that of a double flap velum made to fit the margins of the cleft, and for the purpose of moving with the muscles of the soft palate. This velum was the result of a series of experiments which he had made with the far more complicated appliances of his predecessors, Snell and Stearn. The large upper flap passes over the nasal borders of the cleft and extends backwards to meet the posterior wall of the pharynx. The second, smaller flap, just covers the edges of the cleft, on the oral surface, and its posterior border is immediately in front of a line corresponding with the base of the uvula. This apparatus was a great advance upon anything which had been suggested before but its construction frequently presents difficulties, and sometimes the larger nasal flap causes discomfort to the patient. Moreover, its oral surface does not correspond closely with the normal outline of the palate.

In 1905, Dr. Case suggested a modification of Kingsley's appliance which he called a "velum obturator." This has a large nasal flap like the "Kingsley" except that the edges are thicker to prevent curling up and tearing. The oral flap of the "Kingsley" is replaced by two wings which pass downwards, gripping the edges of the cleft. Dr. Case claims that after the soft appliance has been worn for several months a hard vulcanite appliance, made in the same mould, can be substituted without interfering with the improvement in speech. The construction of Case's velum is somewhat simpler than that of the "Kingsley," but the velum retains the defect of an irregular oral surface.

The modification which I have adopted consists of a large flap of soft rubber representing the oral surface of the palate, whilst to the nasal side of the appliance two wings are attached (figs. 1 and 2). These wings fit round the borders of the cleft. This arrangement just reverses the position of the wings as used by Dr. Case. In most instances it is sufficient to attach the soft rubber directly to the plate covering the hard palate by vulcanizing it on to a metal spur extension, but, when greater freedom of movement is required to secure accurate speech, it is quite simple to make a hinge attachment, and, with the addition of a simple elastic ligature between two hooks, fitted to the nasal surface of the plate and velum respectively, closer adaption can be obtained (fig. 3).

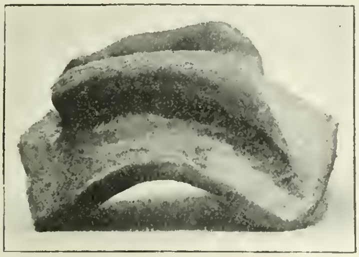

FIG. 1.

Side view of velum.

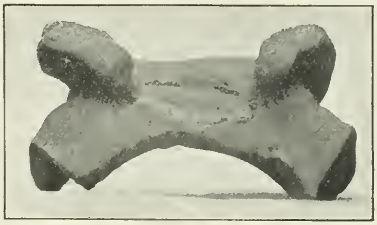

FIG. 2.

Front view of velum.

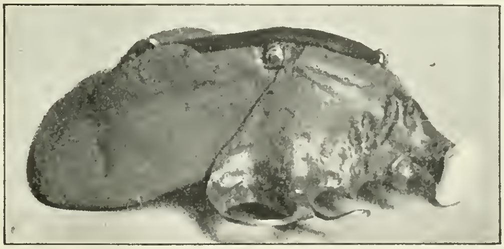

FIG. 3.

Hinged velum, with elastic ligature attached.

In the construction of these vela two or three important points must be borne in mind if the rubber is to remain serviceable for any length of time.

(1) The border should be thickened to prevent tearing.

(2) The edges should be closely adapted to the soft tissues on each side.

(3) The vulcanization should be spread over a long period of time and the pressure must be raised gradually.

My own practice is to start the vulcanizer at 212° F. and to raise the temperature 5° per hour, over a period of twelve hours.

The advantages of this velum are: (*a*) In having a smooth oral surface it is more suitable for the production of correct speech. This is important, bearing in mind the position of the tongue in the production of certain consonants: such as S, K, G, NG, CH, &c. (*b*) It is more simple in construction than the "Kingsley" or the "Case" velum, and the dies required for the reproduction of the velum can be obtained easily. (*c*) It is unnecessary to take any extensive impression of the nasal surface of the palate.

Whereas soft rubber vela usually last only from six to twelve months, under favourable circumstances vela made in this way will last from three to five years, and in view of the fact that speech is nearly always better with a velum than with an obturator it seems hardly worth while to make the change to the harder and immovable appliance if so long a period of utility can be obtained.

Section of Odontology.

President—Mr. W. H. DOLAMORE, L.R.C.P., M.R.C.S., L.D.S.E.

The Relation of Dental Sepsis to Rheumatism and Allied Conditions.[1]

By J. G. TURNER, F.R.C.S., L.D.S.Eng.

THE rather ambiguous expression "Rheumatism and Allied Conditions" has been deliberately chosen. It permits of an almost unlimited range of discussion; it agrees with the general elastic use of the term "rheumatic;" and it certainly reflects the state of my own mind after reading recognized text-books of medicine.

The list of the diseases, or conditions, which may be included is a long one. Rheumatic fever (acute rheumatism); chronic rheumatism; rheumatoid arthritis, acute, subacute and chronic; osteo-arthritis, spondylitis deformans: acute gout, chronic gout, rheumatic gout, irregular or atonic gout, retrocedent gout; neuritis, fibrositis; chorea, pneumonia, pleurisy, peritonitis, meningitis, periostitis, iritis, which are noted as complications of acute rheumatism; valvular disease of the heart, myocarditis, anæmia, all specially related to acute rheumatism; dyspepsia, interstitial nephritis, cardiac and cardio-vascular diseases, subacute and chronic bronchitis, gastric and hepatic derangements, eczema and other intractable skin diseases, hot itchy eyeballs, migraine, epistaxis, glaucoma and iritis, gouty sore throat, gouty gums, included as symptoms of irregular or atonic gout; vomiting, diarrhœa, dyspnœa, arrhythmia, pericarditis, delirium and coma, as symptoms of retrocedent gout.

This is a fairly comprehensive list and practically includes all the more common minor ailments of civilized humanity, chiefly by reason of the allied conditions. Not long since indeed, it seemed as if all medicine was to be overwhelmed beneath a flood of uric acid and irregular gout, and I have seen it seriously argued that ingrowing toe-nail is a gouty affection, the writer having mistaken the accumulation of dry epithelium often found for uratic deposits.

If anyone be inclined to dispute the inclusion of gout in my list, I refer him to the following from an authoritative text-book: "The diagnosis of acute gout is not difficult except sometimes from acute rheumatism," while the diagnosis between chronic gouty and rheumatic conditions has been a perennial source of futile endeavour.

Concerning the list of what appear to be regarded as primary and distinct diseases it must be noted that the term "rheumatic gout" is practically extinct, that at least one authority suggests dropping the term "chronic rheumatism," and that the same authority would include rheumatoid arthritis, osteo-arthritis, spondylitis deformans as one disease; it is also generally agreed that acute rheumatism is a disease distinct in ætiology from all the others. There seems to be considerable difficulty in the diagnosis of these diseases. This is regrettable, but until the diagnosis carries with it more certain and hopeful indications for treatment than at present seems to be the case, the uncertainty is immaterial.

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[1] At a meeting of the Section, held March 21, 1921.

The present-day tendency in medicine is to divide disease into two classes—those due to germ infection and those not due to germ infection—and if in any case coming within our category instead of worrying over diagnosis we inquire whether there is a source of infection and test the result of treatment directed to its removal we may arrive at a conclusion of practical value.

The first question, then, to be put, is whether any of these cases occur in the absence of a focus of infection. If we do but remember the universal presence from babyhood to old age of but two foci—nasopharyngeal disease and dental disease—and disregard all the other possible foci, the answer as concerns a community such as our own is decidedly "no." Turning only to dental infection, we see that teething troubles are due entirely to infection of the crypt of the crown of the erupting tooth as soon as ever there is a connexion between it and the mouth-cavity. From this point of time onwards it is rarely that an absolutely healthy mouth is found, and even so, what we judge clinically to be an absolutely healthy mouth may be proved by laboratory methods to be a carrier of disease. It is important to note that the septic state once established is permanent and always in action. The factors of dental sepsis are well known—stagnation of germs and food débris among the teeth in every possible stagnation area, and sequent to this, dental caries, dead teeth and chronic abscesses, tartar, pyorrhœa: artefact stagnation areas of crowns, bridges, bad fillings and plates. Here I would remind you that dental sepsis, even in an aggravated form, is very common in quite young children and the fissured and swollen tongue so often seen in children is one of its results. There is indeed one stage of pyorrhœa which is oftenest found in children, the stage I have termed that of "solid stagnation." In this stage there are to be found under the edges of healthy-looking gums small, soft, smooth, solid, whitish masses. These masses are putrid and are almost solid masses of germs. They are of the same nature as the plugs found in septic tonsils.

Why is it that everyone has not some form of rheumatism or gout? Probably every one has. Growing pains in children, fleeting joint pains, muscular pains or cramp in adults; bilious attacks, indigestion, migraine, even chronic ill-humour, and in fine all the minor ailments which have been so industriously swept into the net of rheumatism and gout are in most cases the result of germ infection; and considering the unfortunate predominance of dental sepsis it follows that dental sepsis must bear the greater share of the responsibility.

Excepting gouty sore throat and gouty gums, which at least till lately were current medical or dental terms, the list of allied or associated conditions given above was taken from two recognized text-books. For comparison I have compiled a list from 106 cases of which I have notes in my own private practice. It comprises lumbago, sciatica, neuritis, muscular rheumatism, fibrositis, cramp, flat foot, constipation, colitis, indigestion, gastritis, dilated stomach, bilious attacks, acute glossitis, chronic septic stomatitis, chronic sore throat, tonsillitis, migraine, dizziness, headache, sleeplessness, tiredness, depression, nervous breakdown, anæmia, episcleritis, rheumatic iritis, chronic glaucoma, effusions into the retina, periosteal nodes, subcutaneous nodes, eczema, blotchy eruptions of the face, acneiform eruption of face, muddy complexion, yellow conjunctivæ, pernio, chronic bronchitis, tachycardia, onset of deafness, persistent rise of temperature, (?) pernicious anæmia, enlarged submaxillary glands, loss of weight, endocarditis, Graves' disease, exaggerated reflexes, slight cerebral embolus. The list of what we may call the primary arthritic rheumatic and gouty conditions comprises all those enumerated above, including rheumatic fever and acute gout. The terms used are those given by the doctor or the patient; my notes are confirmatory of the main facts of disease. Putting aside acute rheumatism from the list of primary arthritic conditions, and endocarditis from the allied or accessory, these allied conditions occur in all sorts of combinations: they may stand alone as the only signs of disease, or may be accompaniments of articular rheumatic or gouty disease. One common bond unites all my cases—the existence of dental sepsis. I have treated them all in one way, by elimination of dental sepsis. The results are decidedly encouraging. Of thirty-three cases without articular symptoms, thirteen were cured, seven were much better, four were improved, eight were untraceable or recent, and one failed because the front teeth were too valuable. Of seventy-three cases with articular symptoms thirty-four were cured, seven were much better, two were not benefited, one died untreated, and thirty were untraceable or recent.

Some of these cases deserve individual mention. Two of them point to dental sepsis as a source of acute rheumatic fever:—

In the first case I was asked to see a child aged 5 who had got over the acute stage of rheumatic fever, but who was not making any progress towards recovery. There had been acute joints and endocarditis with high temperature. I found chronic abscesses of all the temporary molars, which were being preserved to give the child something to eat with. I took them all out, and the child made a rapid recovery. This was ten years ago, and she has never been ill since. You will remember that the expectation is that rheumatic fever will recur.

The second case was that of a young officer who was bedridden with stiff joints and teno-synovitis. Two months previously he had had an attack of "trench fever," at the beginning of which he sweated in bed for four days. This was all the history I could get. He had bad pyorrhœa, and I took out all his teeth except the canines. Four months later he was well and could run. The trench fever may well have been acute rheumatic fever.

The relation of gout to dental sepsis is well shown by the following cases:—

(1) A man with recurrent acute gout of the great toe, a node on the sternum, indigestion and a persistently raised temperature, was entirely cured by extraction of all his teeth, which were badly affected with pyorrhœa. About two years later recurrence of indigestion took place. He was found to be swallowing a purulent nasal discharge. This was cured, and he has had no recurrence. The teeth were taken out nearly twenty years ago.

(2) A man, aged 64, gave the following history: Since the age of 40 he had been subject to attacks of acute gout. In each attack the big-toe joint was the first to suffer, then the knee, and lastly the eyes. The joints were red and swollen, the eyes were bloodshot, the skin round the orbits puffy, and there was intense general headache, especially bad at the back of the eyes; there were tophi of ears and neck. At the age of 64 he had most of his teeth out. They were firm, but stank on extraction, and after each extraction he felt ill and done up. This was seven years ago, and he has had no gout since.

(3) A man in a trade involving much drinking had repeated attacks of gout of the big toe, and then of the knees, with recovery in six weeks. His joints were red, tense and swollen. He had bad pyorrhœa, and all his teeth

except four were extracted. Since then he has had no gout, but he has spasms of pain in the toe with stiffness. He has not altered his habits.

(4) A man, aged 60, brother to the patient in Case 2. For many years he had had gout in the big toe and knees, tophi of neck and ears. When I saw him he was dying of pyæmia. He had very foul pyorrhœa.

It would be interesting to be able to separate the part played in these cases by actual infection, whether through the mouth or the intestinal tract, from that played by disturbed nutrition, which, one would imagine, the swallowing of pus and germs and decomposing food would necessarily entail. The mode of death in the last case suggests that there is true infection.

(5) Another case began ten years previously, with an attack of gout in the feet. This was followed very shortly afterwards by an attack of Graves' disease, and this by chronic rheumatoid arthritis. When I saw her the eyes were still prominent. She was unable to work. Two months after extraction of several pyorrhœic teeth and treatment of the rest she could work, and the eyes were far less prominent.

Turning to the rheumatic cases, one of my most gratifying was that of a man, aged about 50, who came scarcely able to walk even with the aid of sticks and a nurse. He was extremely weak and emaciated. He had chronic arthritis of almost every joint and was losing weight rapidly. He looked like a man in the last stages of malignant disease. I found chronic dry pyorrhœa and six foul gold caps. I took out nine teeth and a year later he was cured. Recovery was slow. In another case a patient with chronic rheumatism of practically all her limb-joints could only walk with the aid of two sticks. Eleven months after the extraction of thirteen teeth she was able to walk upstairs easily without sticks. Recovery was slow.

One of the patients noted as "much better" was a case of osteo-arthritis of the hip in a middle-aged lady. Considering the amount of destruction and deformity found in this disease cure can hardly be expected, but we may hope for arrest of the disease and prevention of worse. Another case was benefited but not cured till an undetected antrum was found and drained.

Respecting accessory conditions my notes frequently mention gastritis, gastric catarrh, indigestion, colitis; and the relation of these conditions to dental sepsis on the one hand and rheumatic or gouty diseases on the other is freely admitted. My notes also mention constipation, the relation of which to dental sepsis may not be so generally recognized. I have, however, cured two cases of chronic constipation by extraction of pyorrhœic teeth.

My notes do not enable me to say whether the pyorrhœic or the dead tooth is the greater danger. Although I fear them both, pyorrhœa is probably the worse evil on account of its extent.

The degree of sepsis necessary to produce ill-results will obviously depend on the patient's power of resistance, which, till the experiment is made, is an unknown quantity, and may be affected by intercurrent factors such as exposure to cold. Such exposure is often the precipitating cause of so widely divergent diseases as neuritis and pneumonia. A very small, almost microscopic, amount of dental sepsis will determine fleeting joint or muscular pains. I have records of one such case in which the pains were kept in abeyance by monthly cleaning of the teeth, but in which minute retinal effusions suddenly occurred. These disappeared when, and not until, two bicuspids showing a very small amount of marginal periodontal inflammation were removed.

The germs themselves may act either solely by toxic absorption, or by actual entry into the tissues. The list of those known to inhabit the mouths and thus to be a potential source of at least toxic infection is a large one: *Staphylococcus albus, aureus*, and *epidermidis*; *Streptococcus brevis* and *longus*, *Micrococcus catarrhalis*; *Diplococcus pneumoniæ*, vibrios, leptothrix; *Bacillus maximus buccalis*, *Bacillus megasterium*; diphtheroid bacilli, sarcinæ, were all found in septic children's mouths examined for me by Dr. Bainbridge at the Royal Dental Hospital.

The list of those now known to invade the periodontal tissues is not so long. Drew and I demonstrated *Streptococcus longus*, staphylococcus, two strains of diphtheroid bacillus, and a spore-bearing bacillus, and I have been able to add *Streptococcus brevis*, pneumococcus, another spore-bearing bacillus, a Gram-negative diplococcus and leptothrix. All these have been judged by their morphological characters in stained sections.

The difficulty of working in a dental hospital unprovided with beds renders progress in the direction of ascertaining the damage done by the various bacteria almost impossible. The failure to provide beds at any large dental hospital is inflicting great injury on the general community.

As regards treatment extraction is obviously the surest method of getting rid of the focus of infection. But I am certain that if dentists realized the large amount of tartar and stagnant material that can be reached by going a little deeper into the periodontal trough than is generally done and the necessity for cleaning the whole circumference of the neck of the tooth, by the daily use of worsted thread dipped in a cleansing, not necessarily antiseptic, solution to effect this cleaning—a large number of teeth would be saved, to the comfort of the patient.

Preventive treatment includes the abolition of all artefact stagnation areas; the avoidance of sticky food—(this, however, is impossible); the maintenance, as far as may be, of a large and regular arch of teeth and timely but not too early extraction to provide for the actual separation of the remaining teeth from each other till it is easy to pass the worsted thread already mentioned between those teeth.

Of the pathological anatomy I have but little to say. In the jaws the inflammatory reaction shows itself both in destructive, or carious, processes and in formative, often sclerotic processes. Later on these lead to lipping of the alveolar border and exostosis of the bone, often of ivory hardness. Similar changes take place in the bone round the affected joints, but while the jaw changes are certainly of infective origin those of the joint bones may be of mechanical origin. There is no comparison to be drawn as between joint and joint since the structures are totally dissimilar.

In the Museum of the Royal College of Surgeons there is a large series of skulls from the South Sea Islands. Among these there are evidences of a considerable amount of pyorrhœa and tooth abscess, and it is noteworthy, as confirmatory of the infective origin of osteo-arthritis, that the worst cases of pyorrhœa and abscess show marked osteo-arthritis of the temporo-mandibular joint.

The general conclusion I draw is that all these conditions are of infective origin and that dental sepsis is the most common focus of infection. To expect that all cases will be cured even by such drastic treatment as total extraction and then to argue from the particular to the general in cases of failure is manifestly absurd. There may be other foci of infection—an intestinal tract may remain permanently infected or deranged, or the damage may be beyond repair; while the transported germs will certainly not be killed by removal of the original focus of infection; they must be dealt with in their new home.

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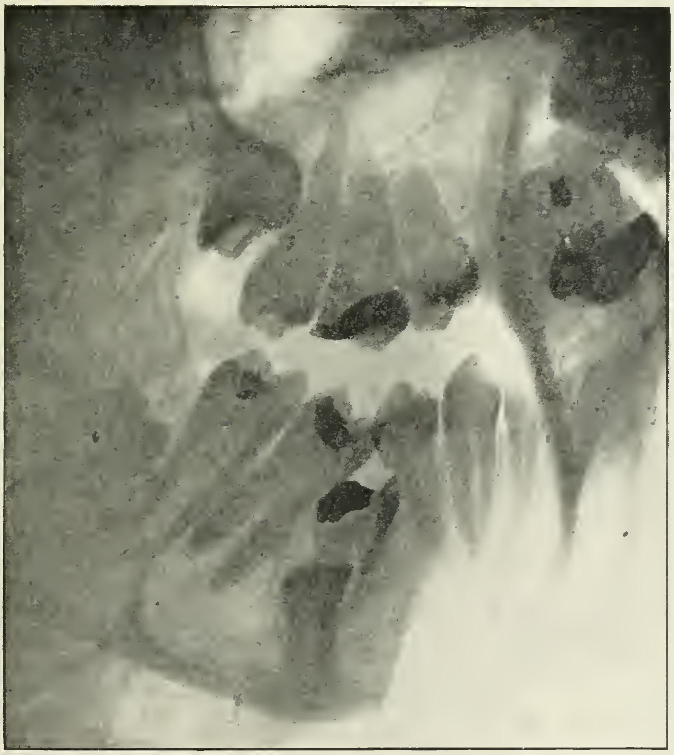
Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

Case of a Deciduous Molar with an Amalgam Filling lying buried in the Lower Jaw, overlapped by the Permanent Teeth.[1]

By D. Reginald Curnock, L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.

The case is that of a young lady, aged 18. She came to my brother as a new patient a few days ago for a simple dental examination to see if everything was all right. The lower second right premolar could not be found, and there was no history of its extraction. Attention was also drawn to this area by the observation of slight tilting of the lower first right molar and the first premolar. A right angle probe was inserted down the pocket of the mesial



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[1] At a meeting of the Section, held January 24, 1921.

surface of the lower first molar, and an enamel crown being felt, it was decided to have an X-ray photograph taken. This shows the second deciduous molar in position, with an amalgam filling on its crown surface. It is buried deeply under the gum, with the second premolar underneath it. The interesting part of this case is the fact that the disappearance of this tooth was so gradual and painless that, although the patient had been to her dentist every three months since she was quite a child, the condition was never suspected. Another interesting fact is the position of the apex of the premolar.

I take it that either the tooth was depressed, first of all by the eruption of the six-year-old molar, and later on by the pressure of the first premolar, or else it has remained at the level at which it erupted, and has been gradually covered over by the permanent teeth and gum.

The patient at the present time has no pain, but having had a similar case in which there was severe inflammation around the unerupted deciduous molar, which took some considerable time to get well, I think that this case should be treated, as infection will sooner or later spread from the pocket on the mesial surface of the lower first molar, and cause a very severe osteitis of the body of the mandible.

The treatment I suggest is to take out, under gas and oxygen, given intranasally, the lower first molar, the deciduous molar and possibly the first premolar, the second premolar being left to erupt of its own accord.

I have also the radiograph of a very similar case which I saw twelve months ago, which suppurated badly. In this case, did the deciduous molar erupt and was it pushed down by the permanent teeth, or did it never erupt at all?

Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

Late Results of Bone-grafts.[1]

By P. P. Cole, F.R.C.S., L.D.S.Eng.

THE X-ray photographs brought to the notice of this Section exhibit the condition of two bone-grafts as they appear two years after operation. In both cases the pedicled bone-graft method introduced by myself was employed, and I show them to emphasize two particular points.

First, to demonstrate the permanence of these results, because surgeons of eminence foretold the ultimate absorption of the graft, and reversion to the condition of non-union. There can be little doubt that this gloomy prophecy has been falsified, for the clinical condition entirely supports the X-ray evidence of firm union, the junction of graft and mother bone being indistinguishable.

Secondly, they vindicate my assertion that, once a bony bridge has been established, thickening will inevitably take place in response to stress. Crystallization of experience as set forth in Wolff's law has provided a sufficiently solid basis for this confident belief, but members of this Section cast doubts upon this favourable outcome, and raised an objection to this method of grafting. Again, it will be evident that these forebodings have not been justified. In the one case the graft measures 3 cm., and in the other 4·5 cm. This latter measurement represents the practical limit of applicability of the pedicled graft. But within the limits of its application the pedicled graft has never, in my hands, failed to secure firm bony union giving a success percentage of 100.

In three instances, in order to secure union, I have operated on previously grafted cases in which sinuses complicated failure, and the results of renewed operation have been uniformly successful.

Another small point worth notice is that the wires binding the graft in place are still in site, showing that non-absorbable fixation material is not detrimental to the growth of bone, and does not set up irritation necessitating its removal.

Some Clinical Cases associated with Dental Infection.[1]

By W. Warwick James, F.R.C.S., L.D.S.Eng.

THIS paper is a converted casual communication written at the demand of our Secretary. It seemed that it might be an occasion at which some of our experiences could be recorded, for now during several years we have studied the teeth as a site of infections, yet our knowledge of this matter is distinctly deficient. I intend quoting cases which have occurred in my own experience.

An infected mouth affects the general condition of the patient—

(1) By local action and extension to neighbouring parts.
(2) Through the gastro-intestinal and respiratory tracts.
(3) Through the blood and lymph-vascular systems.

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[1] At a meeting of the Section, held February 28, 1921.

Also, the secondary effect is produced either by the action of micro-organisms or their toxins, or both, after their conveyance to another part.

I caused some amusement, I believe, at the International Medical Congress when I stated that the condition of the teeth had not been ignored, for the tongue had been examined for generations in all illnesses! It is true that fever causes a diminished secretion of saliva, and the mouth more readily becomes foul in consequence, yet if the teeth are infected the state of the tongue will be relatively worse. Directly solid food, the natural cleansing factor, is stopped, the tongue becomes furred. Unilateral furring of the tongue occurs when one side of the mouth alone is used; it is noticeable in those patients who have lost teeth on one side, as after unilateral extraction of teeth; it is seen in cases of malignant disease of the tongue where mobility is limited. Furring occurs on the dorsum and not at the sides of the tongue where friction takes place. These remarks are associated with a case of a medical man several of whose teeth I recently had occasion to remove. He was much distressed about the state of his tongue a few days after the operation. Two premolars were present on the left side, also some incisors. When it was shown how the clean areas upon the tongue corresponded with the teeth present, he was made happier, but he still needed much convincing. When it was pointed out to him that the stomach was over 1 ft. away from the mouth, and that only very rarely did anything pass from the stomach to the mouth, he allowed it was difficult to understand how the mouth could be directly affected by the stomach. He was completely convinced by the introduction of dentures, when the tongue became clean. Dyspeptic ulcers fall into the same category, the dyspepsia and the ulcers being due to the same cause. It is true that the ulcers are often difficult to treat, for they frequently recur. They are due to an abrasion becoming infected; if multiple, the toothbrush is a frequent cause. If a cultivation is made from them, a streptococcus is usually found.

A similar but more chronic condition occurred in a patient who had a small fissure upon the tip of his tongue, which was otherwise normal in appearance. The patient was so anxious about the condition, which had been present for about eighteen months, that he had avoided smoking, alcohol, and other irritants, as he had been directed, but in spite of all forms of treatment the condition persisted. Dental treatment relieved him almost immediately. The lower incisors showed only a small degree of infection, nor was there a large amount of calculus present; the teeth were not carious, so that the medical practitioner who sent the patient to me might easily have been deceived.

Leukoplakia is another condition which may be due to dental infection. In several patients suffering from this condition no other cause could be found. Leukoplakia of the tongue is so commonly associated with other causes that careful notes were kept of cases in which patches corresponding to teeth occurred on the cheeks alone. The distribution of the patches is suggestive; they occur most commonly in the line of occlusion of the teeth, but rather over those of the mandible than over those of the maxilla, giving the impression that the toxic substances tended to gravitate and to act where they remained for the longest period undisturbed, namely, the buccal aspects of the mandibular molars. I will quote one case in which the extraction of the teeth led to the condition being completely alleviated. A lady who had been under my care for many years had suffered from a badly infected mouth. All the maxillary teeth were removed in due course, but the majority of those in the mandible were retained. Small milky patches, hardly appreciable, became recognizable on the cheeks opposite the second mandibular molars; it is interesting that the condition was more or less symmetrical. The teeth, although not badly infected, were removed, as the leukoplakia became more definite and had extended to a patch corresponding almost exactly in size to that of each tooth. After extraction of the teeth, the patch disappeared although the changes were very gradual. A careful examination of these cases suggests that friction plays a part as well as the infected state. An actual infection of the tissue does not seem to occur. I have seen a similar change in the region of the frenum of the tongue; in one patient who will not submit to regular treatment the patch is gradually extending.

An infected mouth at times gives rise to a condition which causes pain at the side of the base of the tongue; very little is to be seen upon examination beyond some redness in the region of the papillæ foliatæ. The pain is not often severe, but may cause great discomfort. It usually appears to be associated with infection of the mandibular molars, almost as if the toxic products passed to the more stagnant area at the side of the base of the tongue. It is cured by dental treatment, which therefore establishes the cause of the condition.

The next group of cases is particularly interesting. For many years I have felt convinced that cases of trigeminal neuralgia are of dental origin and are due to infection arising in connexion with the teeth. This acute form of neuralgia is limited entirely to the second and third divisions of the fifth cranial nerve; some cases appear to have occurred in other nerves, but they are so few by comparison that the above statement would be accepted most probably by the majority of observers. The second point impressed upon one is that successful alcoholic injection of the nerve cuts off the peripheral sensations, and gives complete relief in almost all cases. The stimulus, therefore, must be peripheral. We know the teeth are more often infected than any other area of the body, and that the nerves supplying these areas are those affected, but extraction of teeth rarely gives more than temporary relief in cases of long standing. It is true, complete relief occasionally occurs. One symptom, frequently occurring at an early stage in all cases, is that of heat giving rise to the pain; sitting before the fire is avoided; a hot day is worse than a cool day; in fact a chronic osteitis is suggested. A further analysis of these cases is undesirable in this short paper, but acting upon the idea I had formed that these cases were really due to a chronic osteitis, I carefully opened up the bone and had a cultivation made. The dense bone was gouged away freely, and the wound packed for a short time. It was intended that free drainage should be established, and that by packing temporarily a more acute condition should be induced, as conditions which become acute so often clear up completely. Packing however, was abandoned as too painful, and freer gouging practised. In some of the cases a vaccine was used, for a streptococcus was found in all cases from which a growth was obtained. The cases are of course rare, and those I have investigated might not in every instance be regarded as trigeminal neuralgia major, but they were all of a very persistent and chronic type. Freely gouging away bone has certainly led to complete alleviation in some cases. Perhaps the most interesting fact is the result I obtained in co-operation with Dr. Wilfred Harris. I had discussed the matter with him, and in order to test my views I operated upon a patient of his at St. Mary's Hospital. In my previous cases, the technique of the operation was uncertain, although care was exercised, but at St. Mary's Hospital it was almost impossible to have failed in this respect. The patient still had some pain, in spite of an injection of alcohol; the distribution of pain was that of the second division of the fifth nerve; all the maxillary teeth behind the canine had been removed, and a nodule of bone about the region of the first molar was discovered. A piece of bone was removed under most careful aseptic conditions, and a streptococcus grown from it. Dr. Wilfred Harris has already recorded the fact in a recent paper in the *British Medical Journal*.

The effects of mouth-breathing comprise a subject wide enough to provide material to fill a whole paper, but I will refer to two cases in which patients suffering from asthma were completely cured by rendering them nose-breathers. Curiously both patients were boys at public schools, and about the same age —between 15 and 16 years old. The patient whose condition was the worse of the two was undersized; he had suffered for many years, and was so badly affected that his whole life had been spoiled. His mouth was seriously infected. The other boy was well developed, but not strong; he suffered, but much less than the first boy, and the condition of his teeth was better. The treatment of the mouth, the use of exercises, and the regular use of a mouth-valve at night effected an extraordinary change. The health of each improved remarkably; the condition of the under-developed boy underwent an alteration which was commented upon by all who knew him. It is only fair to say that in some similar cases the change shown has not been so remarkable, but such change as has been effected gave sufficient encouragement to urge the treatment in spite of the greater discomfort in these than in simpler cases of mouth-breathing.

An infected mouth rarely produces an elevation of temperature unless an acute condition is present, but one case in my experience demonstrates the possibility of a rise in temperature with chronic infection. The patient, a man, aged 44, was not well; he had lost weight, and had run a temperature between 99° and 100° F., for two months. No cause could be found; tubercle of the right apex of the lung was suspected, as the expansion was restricted, but the organisms could not be found; he had a slight cough. It was decided to send him away for two months' treatment. Before he went away he was sent to me to have his mouth put in order. He had definite infection of a perfect set of teeth; one molar was extracted, and the remainder treated. He immediately improved, at the end of a week his temperature was normal, and the improvement has been maintained. I had a similar experience in another case; the treatment has been less regular, and the patient much less amenable, but improvement and dental treatment have coincided so remarkably that the patient is convinced of the association between the two.

The large group of cases described as "rheumatic" are so often associated with mouth infection that a detailed account is unnecessary. A hospital patient caused some amusement by being annoyed and most troublesome because artificial teeth were not supplied to him; his argument was that we had removed his teeth, therefore we ought to supply him with others. When asked why he came, he said, "Lumbago, but that's gone!" His physician had described the condition as fibrositis. Of joint affections the peri-articular form is often completely cured by dental treatment, but true osteo-arthritis is most unsatisfactory, from the fact that extraction of teeth is the only course, whilst the changes connected with the joints continue. It would appear that the organisms have become established in the bone if the complaint be of dental origin; the temporary alleviation in some cases suggests this origin, but the progress of the case is usually disappointing. Patients with atrophic changes in the skin, which becomes smooth and shiny, are unfavourable cases for treatment. Another group of unfavourable cases consists of those dyspeptic patients who have obviously suffered for a long time from dental infection, particularly those with chronic dilatation of the stomach. The high resistance of the stomach to infection is remarkable, but once this has broken down it is exceedingly difficult to restore. In spite of this, they are a more favourable group for treatment than those suffering from osteo-arthritis. Eye conditions, such as irido-cyclitis, are frequently of dental origin, and may yield to treatment in a striking manner. One patient, a lady aged 41, had suffered from successive attacks; the teeth were suspected as the cause, and their extraction was followed by a rapid and complete recovery of the eye.

Cardio-vascular changes in a man between 60 and 70 years old were causing anxiety, as he had frequent attacks of giddiness. His teeth, which were infected, were treated and a third mandibular molar just through the gum, which was chronically inflamed, was removed. The giddiness almost entirely disappeared, in spite of closer application to his work, which had been interrupted by his former condition.

Patients suffering from exophthalmic goitre may be benefited by dental treatment. Several cases under my care have shown very great improvement. One patient completely recovered; she had suffered for some years with occasional acute attacks which caused prostration, but which passed off completely. A foul condition of the mouth, which always became ulcerated was associated with the acute attack. She was the wife of a medical man who had procured all the assistance he could obtain from his colleagues. Extraction of a number of teeth with treatment of those remaining was followed by improvement, and within a few months the patient had completely recovered.

Neurasthenics may also be benefited by dental treatment. A great many are sent to the dentist as his is one of the lines of treatment adopted in these cases who drift from one form of treatment to another. They need great care, for they are frequently ill, in spite of being at times most troublesome patients. Patients suffering from dental infection become more easily tired than formerly, may have disturbed sleep, be irritable and occasionally restless. If these symptoms are marked the patient may easily become a neurasthenic. One patient became so restless that an attendant was necessary, the mental balance being disturbed. Complete recovery in due course followed extraction of teeth. In my experience severe headaches in neurasthenics have been alleviated by dental treatment.

The most extraordinary case in my experience occurred in a lady who was so ill that it was thought she would not live. A streptococcus similar in characteristics, had been cultivated from the mouth, blood and urine as the result of several tests. Every joint in the patient's body was affected so that she could hardly move. A vaccine had been made and was being used when I saw her; her mouth had been treated by her dentist. I extracted all the teeth, a desperate measure under the circumstances, but the result was justified, for she now has almost good health. The organism could no longer be cultivated from either the mouth, blood or urine.

Before closing these somewhat disjointed notes I would like to add a remark made by one of my colleagues. He said, "Medical men have been at fault about teeth, but the dentists are now the worst offenders; it seems impossible to get a satisfactory opinion; either they want to remove all the teeth, or they say the mouth is healthy. Is there nothing between?"

Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

The Prophylactic Extraction of the Third Molars.[1]

By A. T. Pitts, D.S.O., M.R.C.S., L.D.S.E.

To many it would seem inadvisable to suggest any further reasons for extracting teeth at the present time: they would hold that teeth are being extracted in such large numbers for reasons so often inadequate that there is a serious risk that dentistry may soon cease to exist as an art without the compensation of becoming a science.

It is quite true that a great number of teeth are being extracted to-day, especially in America, quite unreasonably; this does not invalidate the surgical principles on which such treatment is based, but merely implies a lack of logic and proportion on the part of those who apply such principles in an indiscriminate fashion. There are signs that the responsible leaders of dental opinion in America are realizing this, and that more moderate views will soon assert themselves. Yet when we consider the surgical principles which have been responsible for effecting this change in our outlook, it is impossible to deny their cogency or to fail to recognize the wholesome character of the change they have effected in the practice of our profession. The "master word," as Osler might have called it, in dentistry to-day is stagnation. Our main task is to eliminate stagnation in the mouth. In attempting to restore function we have to be careful that our conservative work does not in itself cause stagnation. Above all we must be sure that all our work is of such a nature that, given a reasonable amount of co-operation on the part of our patients, the improvement we have made is maintained. Accepting these principles I therefore bring before you some additional reasons for extracting teeth which appear to me to be worthy of consideration.

The title of my paper implies that I deliberately advise the extraction of the third molars in order to prevent stagnation and subsequent infection, and that this should be carried out at as early a stage as possible as part of our preventive measures against dental sepsis, before there is any recognizable morbid process around them or the patient complains of any symptoms in connexion with them. This may seem to some as absurd as the attitude of a dentist—recently described by Dr. C. N. Johnson—who having filled a tooth for one of his family with a synthetic filling became so obsessed with the possibility of the tooth dying and causing a focal infection, that he promptly extracted it. Any part of the mouth may, under certain conditions, become an area of lowered resistance and lead to infection, but the third molar, particularly in the mandible, for reasons implicit in its anatomical connexions, is, to my mind, such a constant danger zone, that we are justified in urging its extraction in the vast majority of cases at the earliest possible moment.

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[1] At a meeting of the Section, held May 23, 1921.

Anatomically and functionally the third molar is the least important tooth in modern man; pathologically it is the most important for, more than any other tooth does it lead to conditions which may be sufficient to cause death, and, short of this, it does very frequently lead to conditions of varying severity. These are well brought out in an instructive chapter contributed to Bennett's "System of Dental Surgery," by Warwick James. The reasons which render the third molar in the mandible so important from the pathological standpoint follow naturally on those which make it an unimportant tooth functionally. Without entering too fully into the anatomy of the third molar some reference must be made to it, for my argument depends primarily on that.

The third molar tooth both in the upper and lower jaw is a degenerate tooth. According to Duckworth this degeneracy commences even in the gorilla and is progressive in man. But more important from our point of view is the fact that there has been a progressive shortening of the body of the jaw, so that the third molar when it erupts encroaches on the coronoid process, with the result that eruption remains incomplete. We can distinguish two varieties of incomplete eruption in the third lower molar: first, it may be incompletely erupted in relation to the bone; secondly, eruption may be complete as far as the bone is concerned but incomplete in relation to the soft tissues. The first variety includes all conditions of impaction, where the position of the tooth is such that there is a mechanical obstacle to eruption; but in many cases even where impaction is absent, such teeth may remain partly erupted for an indefinite period. At intervals there is an attempt at eruption usually accompanied by discomfort, and the tooth may gradually struggle into a condition of complete eruption as far as the bone is concerned. The second class of imperfect eruption in relation to the soft tissues is a much larger one: indeed it seems to me that we may say that the lower third molar is with rare exceptions always imperfectly erupted in modern European man. If we examine a mouth in which conditions are favourable in that there is no crowding and all the teeth are present, and look at the lower third molar, we find the following conditions: The tooth is usually of good size; it may have erupted without giving any pain; the occlusal surface may be on a level with that of the second molar, and it may occlude with the corresponding upper molars. On the buccal aspect the gum may be tightly bound down to the neck of the tooth and the gingival trough of normal depth; anteriorly and lingually the soft tissues may be equally normal. Such a tooth would be regarded by many as quite normal, and if it became carious they would consider conservative treatment of it justifiable. If now we examine the posterior surface of the tooth we find a quite different condition. Instead of the body of the jaw extending backward beyond the tooth and being covered by gum which is tightly bound down to the bone except where it bounds a gingival trough of normal depth, we find that the posterior surface of the tooth is in close relation with the ascending surface of the coronoid process, like a house built partly into the side of a hill; the soft tissue covering the anterior surface of the coronoid is in contact with posterior aspect of the third molar and constitutes an enormously exaggerated gingival trough. The level of the soft tissue varies; in some cases it is higher than the occlusal surface, and a small tongue of tissue lies between the posterior cusps. In other cases the gum may be on a level with the occlusal surface or in a varying degree below it, but always in my experience constitutes a gingival trough many times deeper than normal. Indeed it is doubtful whether we are justified in speaking of the space behind the third molar as a gingival trough. There is evidence to show that the gingival trough normally possesses a definite phagocytic property sufficient to prevent stagnation from occurring in the space under healthy conditions. The area behind the third molar should be regarded as a dead space peculiarly favouring stagnation and not possessing the physiological properties associated with the gingival trough proper. The gingival space on the lingual aspect may also be much deeper than normal, especially in the posterior third of the tooth, and evidence of chronic congestion is frequently present. But in addition to this the character of the soft tissue behind the third molar differs from that in front. The latter is tightly bound down to the bone; the tissue behind is soft and loose, and insensibly blends with the mucous membrane of the pharynx, floor of the mouth and cheek. This factor has long been recognized as playing an important part in the spread of infection from the third molar and determining its path backwards.

Such are the anatomical features associated with the lower third molar. What inferences may be drawn from them to justify my contention that the third molars should be extracted as early as possible and without regard to whether they are causing recognizable symptoms of pain or inflammation? The answer may be put briefly. Consequent on the imperfect eruption of the third molar almost invariably present in modern jaws, there is a peculiar liability to stagnation around this tooth, and indeed, in my experience, such stagnation can be always demonstrated. If we take a mouth in which all the teeth are present and obviously functional, in which stagnation due to crowding of the teeth, mouth-breathing, periodontal disease and faulty conservative work are absent, we still find stagnation behind the third molar. If a probe be passed down behind this tooth it is surprising how much foul débris can be removed. It is in a place so inaccessible that it is not removed by the stimulus of efficient mastication; it cannot be removed by the toothbrush or by using a mouth-wash; while the difficulties of reaching the area with silk or wool are too great for it to be hoped that the ordinary individual will ever be successful in this.

Not long ago reference was made to the stagnation which habitually occurs around the third molar; I had long noticed this myself, and it had led me to formulate the idea that these teeth should be removed as early as possible in the majority of cases. I have met with varying success in persuading patients to part with these teeth. Frequently they decline to lose teeth which, from their point of view, are giving no trouble, and not unnaturally, their objections seem reinforced by the fact that often other dentists have carried out extensive conservative work on the third molars.

As to how far my arguments will seem valid depends on two things: first, what significance attaches to the presence of this stagnant area, even in the absence of recognizable symptoms? Secondly, is there evidence to show that this region becomes an area of lowered resistance leading to definite infection, in a number of cases sufficiently large to warrant our advising the extraction of the third molars, even where obvious signs of infection are absent and the teeth are of functional use?

As to the first question it depends on the significance which the dentist attaches to the presence of stagnation. If he holds that its elimination is his chief task and that its presence in the mouth can never be regarded lightly, no matter how healthy the patient may appear to be, then these arguments may seem to have some force. If, on the other hand, he concedes the theory without any real conviction, not hunting for areas of concealed stagnation but waiting until they are forced on his notice, then he may consider that my arguments are an example of theory "running amok." If, as is unfortunately true of a few, the dentist is frankly sceptical, both in theory and practice, of the gravity of stagnation and regards dentistry as a branch of architecture in which foundations scarcely matter, then he will consider my plea ridiculous.

With regard to my second point, I think there is a good deal of evidence to show that the third lower molar is an area of lowered resistance. Where the tooth is imperfectly erupted in regard to the bone, and especially when it is impacted, the anatomical conditions frequently lead to infection which may have very serious results. If actual impaction is absent, serious symptoms necessitating urgent extraction may only arise in a few cases, but in a considerable number of people there is evidence of a definite sub-acute infection which at periods becomes exacerbated and gives rise to symptoms of pain and local swelling or ulceration. This often appears to be correlated with periods of eruptive activity. Even in these cases the balance between the resistance of the tissues and the infection may be depressed in favour of the infection, and an acute condition may result. If this does not happen in course of time the tooth may struggle into place, completely as far as the bone is concerned, but almost invariably incompletely in relation to the soft tissues. In many cases, if the dentist is consulted, he will advise an expectant treatment, and if the result I have described in the previous sentence follows, he may regard it as ample justification of his delay. I have frequently seen such cases in which there has been a history of occasional discomfort and eventually the tooth has come through into occlusion. I have often found evidence of definite infection ; not merely stagnation but actual ulceration of the muco-periosteum and a condition of local pyorrhœa. I believe that many cases of pyorrhœa commencing in the molar region can be traced to the third molar. Another fact that suggests that the third molar is an area of lesser resistance is that, according to Maurel, in mercurial stomatitis the gum behind the third molar frequently shows signs of infection in advance of the rest of the mouth. It may remain limited to this region and be present on one side of the mouth only, usually the side on which the patient rests at night, another point which emphasizes the rôle which stagnation plays in predisposing toward infection.

In acute ulcerative stomatitis, which occurred so commonly among the troops in the Great War, it was frequently observed that the infection had commenced around the third lower molar. I often saw such cases in which the tooth was in occlusion and free from caries, and it was obvious that the stagnation which I believe to be habitually present had acted as the predisposing cause in favouring the selection of that site for the commencement of the disease.

These are the reasons for stating that stagnation around the third molar does lead to a lowered resistance of the tissues in that part.

It may be argued that infection occurs in too few cases to justify extraction of teeth useful for mastication, but I believe that a careful investigation of the clinical history would show that in a far greater number of cases than is commonly imagined, there has been at some time a definite infection. But even beyond all this I would still advocate extraction of these teeth on the grounds that an area of persistent stagnation can only be harmful to the patient, and that what I have termed prophylactic extraction, before any symptoms arise, should be carried out. It is admitted that the operation is severe and that after-pain is common, but I would suggest that the severity of the operation and the amount of after-pain is often increased by the fact that extraction is not resorted to until there is definite infection. I believe that early extraction would obviate much of the pain.

With regard to the maxillary third molar, anatomically its position does not favour stagnation in the same way as the lower third molar, but whenever the lower tooth is extracted the upper tooth should also be removed as well, for under these conditions it is entirely functionless and, if left, will soon become a focus for stagnation. Of course there are certain exceptions. Very rarely the mandible may be so well formed that the tissues behind the third molar are normal and do not favour stagnation. Such cases I believe to be extremely rare in modern man. In a larger number of cases the space created by early loss of some of the anterior teeth has allowed the third molars to come forward. Under these conditions there may be no special liability to stagnation and the teeth can be safely left.

I am aware that there is nothing novel in what I have said and I believe that many dentists have for long practised what I am preaching. I have often been surprised, however, to note how frequently patients who obviously pay regular visits to the dentist show conservative treatment of the third molars. Often the work is so extensive that it must have taken a long time and entailed a severe strain on the operator. Sometimes it is carried out in teeth which scarcely have the justification of being in occlusion with the upper molars. It is very evident therefore, that many dentists regard these teeth as being sufficiently valuable to be worth saving when carious, and are the less likely to consider it justifiable to extract them when they are free from caries and not the cause of any pain. For these reasons I have thought it worth while to put before you the anatomical and pathological arguments which to my mind justify early extraction of the third molars on the ground that by so doing we are eliminating an area of stagnation from the mouth which, there is evidence to show, acts as a predisposing factor to infection in many individuals.

Section of Odontology.

President—Mr. W. H. Dolamore, L.R.C.P., M.R.C.S., L.D.S.E.

The Dental Aspect of the Treatment of Congenital Cleft Palates.[1]

By W. Kelsey Fry, M.C., M.R.C.S., L.R.C.P., L.D.S.

(Director of the Dental Prosthetic Laboratory, Guy's Hospital.)

During the war I treated a large number of gunshot wounds of the maxilla resulting in perforations of the palate, and throughout the whole of that time it often occurred to me that the knowledge and experience thus gained would prove of the greatest value in the treatment of congenital cleft palates. I fully realize the great difference between the treatment of gunshot wounds and that of congenital cleft palates, but several of the general principles governing the former have been found applicable to the latter. Together with my war experience, I have during the last two years had under my care at Guy's Hospital about fifty cases of congenital cleft palates in patients, varying in age from 1 week to 40 years, and in the treatment of these most difficult cases, I have found the knowledge gained through the treatment of gunshot wounds of the greatest help.

I want to point out to you the reasons why, from a dental aspect, I consider surgical closure of the hard and soft palates in cases of congenital cleft palates to be undesirable, especially early operations in cases of complete clefts, and to describe the lines of treatment that have proved most successful in my hands.

In the anatomical aspect of these cases we are most concerned with the muscles which enter into the formation of the soft palate and the posterior wall of the pharynx. The muscles concerned in the movement of the soft palate are the levator palati, the tensor palati, the azygos uvulæ, the palato-glossus, and the palato-pharyngeus. The action of these muscles is to raise or lower the soft palate to enable it to make or break contact with the posterior wall of the pharynx whenever necessary. The muscle chiefly concerned with the posterior wall of the pharynx is the superior constrictor.

It will be readily understood that cleft palate patients are better able to articulate vowel sounds than consonants because they are unable to form the closure to the expiratory blast by reason of the free opening which exists into the nasal cavities.

The important part played by the soft palate will also be understood, first, in shutting off the oral from the nasal pharynx, and secondly, in assisting the tongue to close this door to the expiratory blast in sounding consonants like K. We must also remember the importance of the upper lip and teeth being in correct occlusion with the lower lip and teeth in order to obtain proper articulation in speech.

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[1] At a meeting of the Section, held June 27, 1921.

It is often a matter of great wonder that cleft palate patients, who have never had treatment, are able to speak so well as they do. From careful examination of these patients I have frequently noticed how extraordinarily well the remaining tissues adapt themselves to the peculiar circumstances in order to prevent both food and air passing between the oral and nasal cavities. The action of the superior constrictor is greatly increased (as pointed out by Passavant) to form a definite bulge on the posterior wall of the pharynx, known as the Passavant cushion. The remaining parts of the soft palate also attempt to approximate themselves, especially during the act of deglutition (*see* fig. 1), whilst the posterior portion of the tongue assists the speech, through being drawn up by muscular action into the perforation. Again, the muscles of the alæ of the nose are often much hypertrophied and definite contraction of the nasal airways takes place, thus regulating the amount of air entering through the nose during speech. Also, the turbinate bones, especially the inferior turbinates, are hypertrophied, most probably owing to chronic inflammation, but nevertheless with considerable advantage to speech.

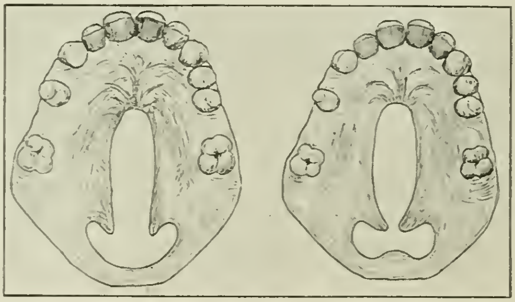

FIG. 1.

In discussing the treatment of congenital cleft palates it will be of assistance first to consider our ideals, and then to compare the results of the various types of treatment in use at present, to discover how far they succeed in realizing these ideals.

The ideals to be aimed at are: (1) The good general health of the patient; (2) good speech; (3) good mastication; (4) good appearance.

The types of treatment in general use at the present time fall under three classes, viz.: (1) Surgical; (2) prosthetic; (3) surgical-prosthetic.

(1) SURGICAL.

The chief surgical operations now in use are the Langenbeck, the Lane, and the Brophy, all of which have for their object the closure of the perforations of the hard and soft palates. As we are aware, these operations are not always attended by the most favourable functional results, and I venture to say that the results are generally regarded with more favour by the surgeon than by the dental prosthetist. To attain the ideals enumerated it is necessary not only to obtain a closure of the perforation in the hard and soft palates, but also to obtain a functional soft palate, that is, a palate with its muscles intact and able to make contact with the posterior wall of the pharynx, thus closing off the oral from the nasal cavity. It is not usually realized by the surgeon that cases which result in a short soft palate, and which, owing to defective speech, are eventually sent to the dental prosthetist for treatment, are far more difficult to treat and much less satisfactory in results than those cases which have been entirely treated by the dental prosthetist. Again, the closure of the hard palate with the consequent loss of occlusion of the teeth is entirely unsatisfactory from a dental aspect, especially in view of our present day knowledge of the fact that non-functional teeth are very liable to periodontal disease. In considering these cases from the point of view of occlusion of the teeth it is interesting to note Brophy's statement that there is no loss of tissue at birth in congenital cleft palate patients, and on this fact he bases his operation of approximating the fragments at an early age. Judging from my experience of a large number of cases I doubt the accuracy of this statement, and I hope to bring before you at some future date full data to substantiate my opinion ; but at present I shall simply show you a few models bearing on the subject. Fig. 2 shows a model of a normal maxilla and a model of a cleft maxilla, both impressions being taken at full-time birth. The transverse measurements A-B are identical in both cases, so that in this instance at least there is a definite loss of tissue, and approximation of the two halves would result in a contracted arch.

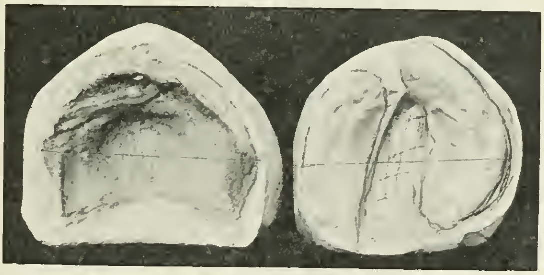

FIG. 2.

Figs. 3 (*a*, *b*) and 4 show models illustrating in a remarkable manner the good occlusion which is invariably present in cases which have not been operated on; therefore, we know that from the age of 2 years there is a definite loss of bone, and the probability of this being due to atrophy, as suggested by Brophy, is very slight since the teeth in these cases have been functional.

In the Langenbeck and the Lane operations the perforation of the hard palate is closed by soft tissues with the result that a certain amount of scar tissue is formed. In view of the great contracting tendency of scar tissue there is therefore no wonder that a large number of these cases, especially cases of early operations, when the bones are easily moulded, result in a contracted arch. This fact is particularly noticeable in cases of complete palatal and alveolar clefts; whilst in cases of perforation of the posterior part of the hard palate only, the approximation of the two halves is not so great (owing to the resistance of the unaffected part), but the contracting tendency of the scar tissue draws the newly-constructed soft palate forwards with unfavourable functional results.

By means of X-ray examination I have frequently demonstrated this tendency of the two halves to be approximated by the contraction of the scar tissue, the cleft being indicated on the films by a very narrow space.

There are two advantages often claimed for early operations in these cases —first, that the infant is better able to take nourishment, and secondly, that the final result in articulation and speech will be better if the child is not allowed to develop the usual cleft palate habit of faulty articulation. There is certainly some truth in the claim that early operation is beneficial for the child's nourishment, because if the child is not operated on it remains at home,

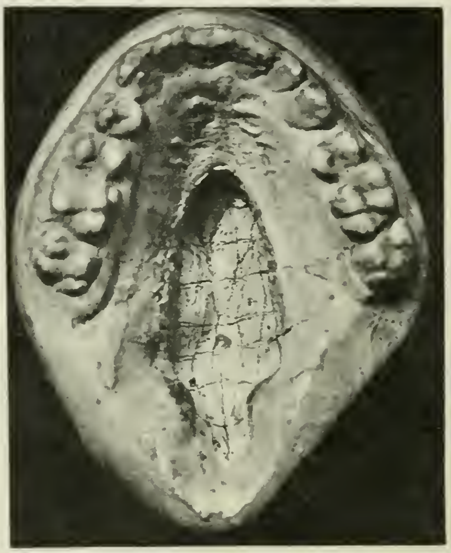

FIG. 3 (*a*).

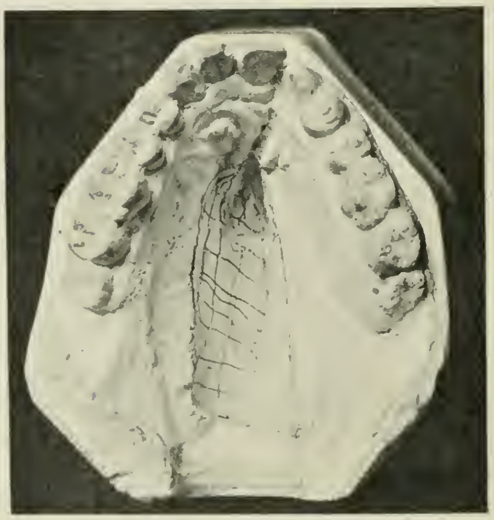

FIG 3 (*b*).

where spoon-feeding is carried out with little knowledge of the proper diet or of the means of administering it; whereas if an early operation is performed, the child is brought into hospital and is there placed on suitable diet administered by trained nurses. As a result of inquiries from a large number of nurses who have had these cases under their charge, I have ascertained that the child has to be spoon-fed both before and after the operation, as the operation does not render it able to suck at the breast or from the bottle. I have had infants brought to me for treatment who have been wasting rapidly through this lack of proper knowledge of feeding, and when they have been admitted into hospital, they have immediately benefited in the same manner as the cases admitted for operation.

With regard to the claim that the child is liable to develop the habit of faulty articulation unless an early operation is performed, you will probably agree that the cases which I am exhibiting prove that, even when no operation or prosthetic treatment has been performed until mature age, very satisfactory results in articulation of speech are easily attainable by prosthetic treatment at that age. These cases are of further interest owing to the fact that the patients have never had the services of a speech-trainer either before or after the prosthetic treatment.

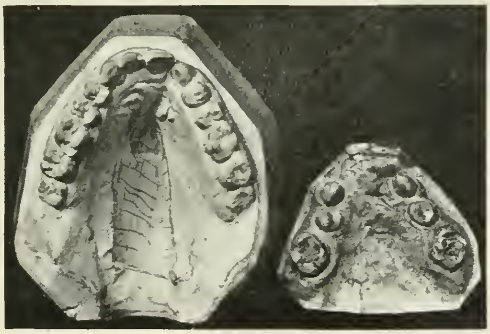

FIG. 4.—Models illustrating contrast in size of maxilla in an unoperated and an operated case.

For these reasons I consider it undesirable that the operations in use at present should be performed upon cleft palate patients, especially at an early age. The following are my alternative methods of treatment :—

(2) PROSTHETIC.

Cases of congenital cleft palate which come to the dental prosthetist for treatment may be divided into two classes: (*a*) Those which have not had any surgical or prosthetic treatment, and (*b*) those in which the prosthetic treatment required is secondary to surgical treatment.

(*a*) *Those which have not had any Previous Treatment.*

As these cases are liable to be brought to the dental prosthetist at all ages, I will deal with them according to age.

At birth, attention should be directed to aiding the nourishment of the child. When the cleft involves the soft palate and the posterior part of the hard palate only, it is merely necessary to give definite instructions as to the correct diet and to supply the mother with a specially-constructed feeding bottle by which the liquid is projected into the mouth by means of hand pressure (*see* fig. 5). The special feature of this bottle consists in the fact that the desired amount of milk can be projected into the infant's mouth at the same time that the child is sucking naturally at the teat. By this means spoon-feeding is abolished, with its accompanying possibilities of contamination of the food, and a great amount of trouble thus saved. To the infant also there is the advantage that it utilizes its muscles in the act of sucking, thus helping in the development of its jaws.

In cases of complete cleft of the hard palate it is also necessary to construct a small obturator to close the perforation. This greatly assists the infant to suck at the bottle and prevents regurgitation. Fig. 6 shows the impression tray used for obtaining the impression for the construction of this appliance. The impression is taken in composition and the appliance made in hard and soft rubber. Fig. 7 illustrates a type of obturator in general use, and it will be noticed that an attachment is added for fastening a piece of grass line or similar material to the obturator in order to prevent its being swallowed. It is also of importance in the construction of these appliances not to fill the perforation completely with soft rubber, otherwise the pressure is liable to cause enlargement of the cleft. Definite instructions must be given to the nurse in charge of the case that the obturator must only be used during feeding and that it must be kept perfectly clean. These appliances naturally require re-construction from time to time owing to the growth of the child, but by reason of their simple construction this does not entail much difficulty.

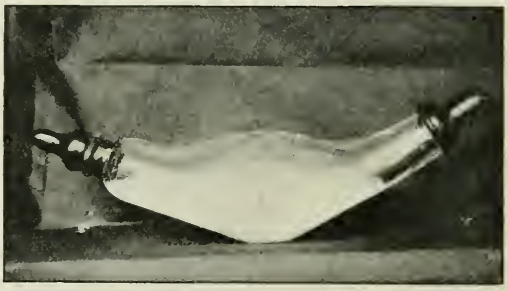

FIG. 5.—Illustrating special attachment at valve end of feeding-bottle.

At the age of 3 to 4 years, when the temporary dentition is complete, it is necessary to construct a small appliance which will cover over the perforation of the hard palate, and thus aid the child in mastication and speech.

From the age of 6 years onwards attention must be directed towards the construction of a prosthetic velum, which will further aid mastication. During the growth of the child from 6 to about 16 years this prosthetic velum must be re-constructed from time to time until it is possible to fit a permanent appliance. The principles involved in the construction of both these temporary and permanent appliances are similar, and I will now describe the type and construction of the appliance which has proved most useful in my experience.

From the unique opportunities I have had of studying the movements of a normal soft palate I have become firmly convinced that it is impossible to reproduce these movements by any mechanical means, such as springs, hinges, &c., owing to the great rapidity with which the normal soft palate moves during speech. It therefore became necessary to study carefully the manner in which nature has attempted to overcome the difficulty of closing off the oral and the nasal pharynx in cleft palate cases, and to seek a method in which the movements so made could be utilized for making the opening and closing movements of this passage. These studies resulted in the construction of the appliance which I am about to describe, in which the attempts of nature to adapt itself to the peculiar circumstances are wholly utilized for opening and closing the passage from the oral to the nasal pharynx. The prosthetic velum is constructed merely to fill the gap which the natural parts are unable to close off at their maximum approximation, with the result that when the tissues are at rest there is a free airway, whereas they are able by their own contraction to close off the opening completely when necessary.

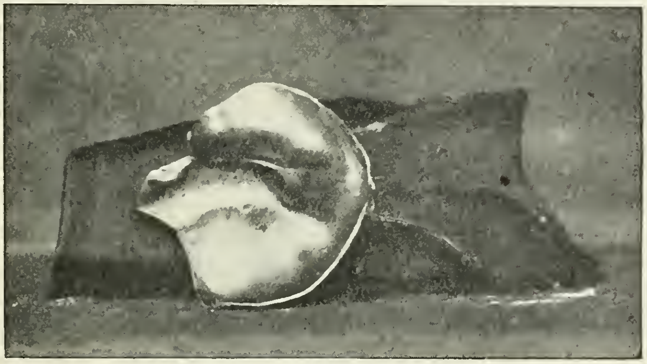

FIG. 6.

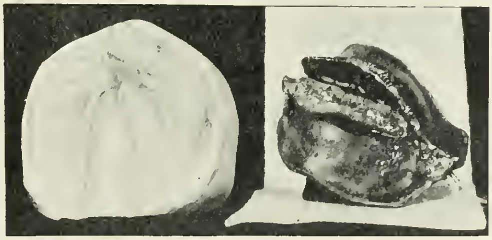

FIG. 7.

In the construction of this appliance an impression of the teeth and hard palate must first be obtained, and for this purpose plaster of Paris is generally used. A special tray may have to be constructed for this, but it is only necessary to obtain a superficial impression of the perforation in the hard palate, as it is merely intended to cover the cleft and not to fill it. A metal or vulcanite base plate is then constructed which is fitted into the mouth, and an impression taken to obtain the correct direction for the flap-carrier, which should occupy a position between and level with the two remaining parts of the soft palate at rest. This metal flap-carrier is next constructed and added to the base plate. The appliance is then returned to the mouth and the individual flaps are moulded, the actual shape and size being obtained in wax. The upper or nasal flap is so moulded that the remaining parts of the soft palate and the posterior wall of the pharynx make contact with it at their maximum muscular contraction. The lower or oral flap is so designed that it occupies the position of the normal soft palate at rest. The function of the nasal flap is to enable the patient to open and close the nasal pharynx at will, and that of the oral flap merely to enable the patient to pronounce such consonants as K and to act as a sounding board to throw the voice forward. The wax moulds having been obtained, they are reproduced in hard vulcanite and finally obtained in velum rubber. The hard vulcanite models are constructed for the purpose of obtaining the polishing plates that are required for the efficient vulcanizing of the velum rubber flaps. This process of using polishing plates obviates the tedious method of using type metal. The velum flaps should be vulcanized for twelve hours, the vulcanizer being started at 5 lb. pressure and raised 5 lb. every hour until the maximum of 60 lb. is reached, as advocated by Mr. Lewin Payne. The flaps are attached to the carrier by a nickel bolt threaded to three thirty-seconds of an inch, with a gold head with rounded edges. Gold washers are also made, and the flaps prevented from being displaced by two victoria metal nuts. Fig. 8 shows the completed appliance; this should be worn by the patient for a few days, after which any necessary adjustments may be made, it often being necessary to adjust the posterior edge of the nasal flap.

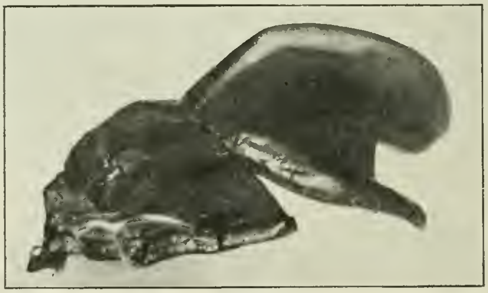

Fig. 8.

It will have been noticed that this appliance does not rely upon any movements of the flaps for its use, and therefore when the patient has become accustomed to the appliance and the shape of the flaps has been definitely decided upon, the velum rubber may be replaced by hard rubber. When this is done, it is advisable to make the exchange in the nasal flap first in order that the change may be gradual.

It is interesting to note that this appliance is merely a modification of the velum, originated as long ago as 1862, by Kingsley, to whose pioneer work on this subject we are greatly indebted.

(*b*) *Those Cases in which the Prosthetic Treatment required is Secondary to Surgical Treatment.*

The type of prosthetic treatment required for these cases naturally varies according to the success which has attended the surgical operation, but generally falls under one of the following heads: (1) The restoration of the soft palate; (2) the restoration of the occlusion of the teeth; (3) the restoration of the contour of the face.

In cases in which the results of operations are very unfavourable, it may be found necessary for the prosthetic treatment to be a combination of two or even the whole of these restorations.

(1) *The Restoration of the Soft Palate.*—When the surgically-formed soft palate is freely movable but lacks length, the prosthetic appliance required is similar to that constructed for unoperated cases, except that the flap-carrier has to be extended to the posterior margin of the soft palate, and it is often merely necessary to make a nasal flap, the surgically-formed soft palate being of sufficient size to fulfil the functions of the oral flap. On the other hand, when the surgical soft palate is only represented by dense scar tissue, the cases are best treated by dispensing with the nasal flap and extending the oral flap to make contact with the Passavant cushion in the posterior wall of the pharynx. These cases do not give such satisfactory results, as it is obvious that the only movements that remain for opening and closing the oral from the nasal pharynx are those of the superior constrictor.

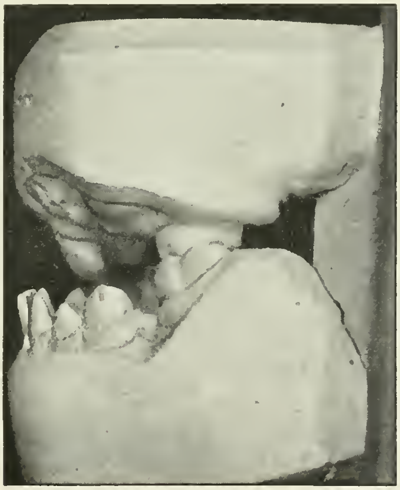

Fig. 9.

(2) *The Restoration of the Occlusion of the Teeth.*—When there is only a small amount of contraction of the dental arch, orthodontic treatment can be adopted with success, but in the more severe cases (which in my experience have usually resulted from early operations on complete cleft palates), the distortion of the arch is so great that it cannot be restored by orthodontic means. Figs. 9 and 10 exemplify such a case, and as these cases are naturally associated with a loss of the contour of the face, I will deal with the treatment under that heading.

(3) *The Restoration of the Contour of the Face.*—Figs. 11, 12 show a photograph and models of a patient with a distinct falling in of the maxilla, upper lip and nose. In the successful treatment of such a case it is essential that, before prosthetic treatment is commenced, the assistance of a surgeon should be obtained to perform an epithelial inlay operation (as described in Gillies' "Plastic Surgery") in order to free the soft tissues from the hard tissues, and enable an appliance (as seen in fig. 12) to be constructed, which will not only maintain the soft tissues in their correct position and thus restore the contour of the face, but will give the patient better power of mastication.

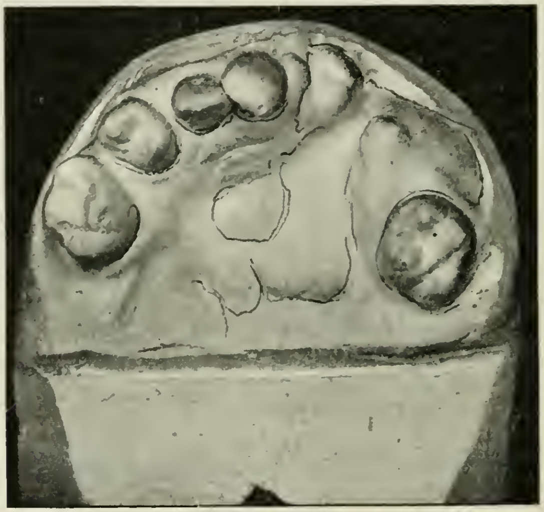

Fig. 10.

(3) Surgical-Prosthetic.

Although the prosthetic treatment for unoperated cases, previously described, fulfils our ideals, it has an accompanying disadvantage, because the patient needs constant attention from the dental prosthetist. I therefore draw your attention to the new combined surgical and prosthetic treatment described by H. D. Gillies and myself, in the *British Medical Journal*, March 5, 1921, pp. 335-338. Its chief feature is the surgical closure of the soft palate and the prosthetic restoration of the hard palate. It has the following great advantages: (*a*) As the perforation in the hard palate is not closed by surgical means, the arch is not contracted, and therefore the occlusion of the teeth remains good, and the appearance of the patient remains unaltered; (*b*) The absence of scar tissue in the hard palate prevents the new surgically formed soft palate from being drawn forward and rendered non-functional; and (*c*) the prosthetic appliance necessary for the closure of the perforation of the hard palate is of such a simple nature that it does not require the services of a dental specialist.

I shall not describe the treatment in detail as the outline has already been published, and a sufficient number of cases have not yet been completed to

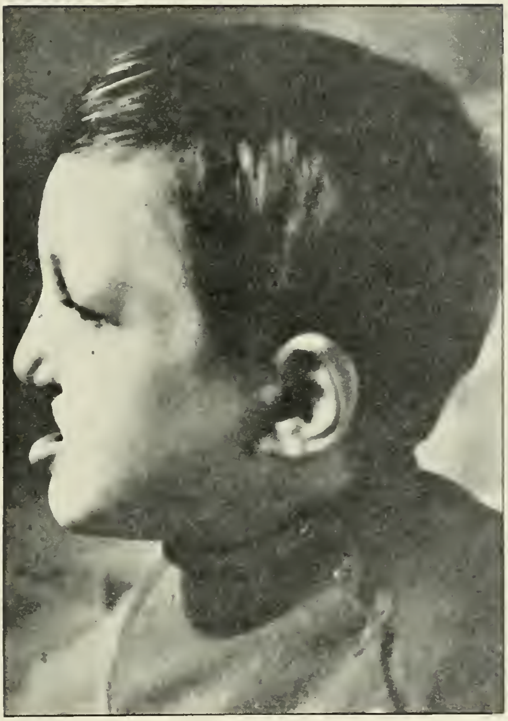

Fig. 11.

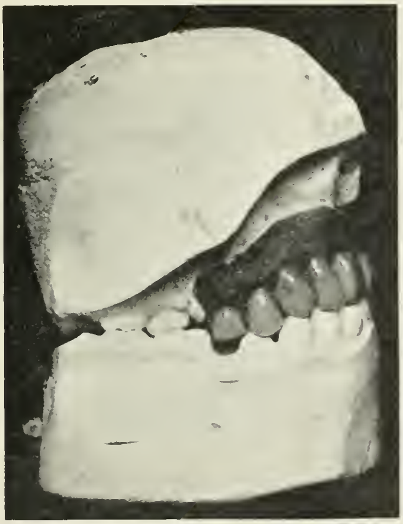

Fig. 12.

enable results to be definitely judged. It is enough to say that this combined treatment promises to solve the treatment of these most difficult cases, both from the surgical and the dental aspect.

In conclusion, I earnestly beg you to reconsider the advisability of recommending early operations for the closure of the hard and soft palates in these cases, in view of the many failures, from a dental aspect, attending these operations. On the other hand, I would ask you to reflect upon the completed prosthetic cases which I have presented to you, and which I am sure you will agree have been attended with remarkably favourable results.

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OF THE

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SIR JOHN Y. W. MACALISTER

UNDER THE DIRECTION OF

THE EDITORIAL COMMITTEE

VOLUME THE FOURTEENTH

SESSION 1920-21

Flo 13

SECTION OF OPHTHALMOLOGY

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LONGMANS, GREEN & CO., PATERNOSTER ROW
1921

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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Section of Ophthalmology.

President — Dr. JAMES TAYLOR, C.B.E.

PRESIDENT'S ADDRESS:

Some Neurological Aspects of Ophthalmic Cases.[1]

By JAMES TAYLOR, C.B.E., M.D., F.R.C.P.

I DO not think I am at fault in thinking that my election is to be regarded as a recognition of the necessity of close co-operation between the ophthalmic surgeon and the physician—a necessity impressed upon me early in my neurological work, and recognized by the last generation. It is interesting in this connexion to remember that when Moorfields Hospital was first established in Charterhouse Square in 1804 it had on its staff a surgeon, Dr. Saunders, and a physician, Dr. Farre. Apparently the surgeon was not allowed to prescribe medicine and the physician's duties consisted chiefly in ordering ointments and aperients, although he saw out-patients as the surgeon did. The elder Dr. Farre was succeeded as physician by his son and he in turn by Dr. Martin whose immediate successor was Sir Stephen Mackenzie, who was a colleague of mine for some years. The long service which the physicians were able to give is noteworthy. The elder Dr. Farre was on the staff for fifty years; his son for thirty-seven; Dr. Martin for twenty-eight, and Sir Stephen Mackenzie for twenty-one. When Sir Stephen Mackenzie was appointed, a new era began in which cases seen by a surgeon were referred to the physician for medical examination and report. This naturally led to investigation, especially ophthalmoscopic investigation, and Sir Stephen Mackenzie's work on the ophthalmoscopic changes observed in anæmias are familiar to all of us.

---

[1] At a meeting of the Section, held November 12, 1920.

It was in 1899 that I had the good fortune to be associated with Sir Stephen Mackenzie as physician to Moorfields and it is interesting to know that every ophthalmic hospital in London now has a physician on its staff.

I wish to-night to allude in a somewhat cursory way to some of the subjects in which ophthalmic surgeons and physicians have a common interest. And I should like to consider these under three headings: (I) Some ocular palsies; (II) visual failure; (III) defects in the visual fields.

(I) SOME OCULAR PALSIES.

I have been struck with the varied conditions under which ocular palsies occur. It is said that sixth nerve paralysis frequently occurs as a result of cold. I have always had grave doubts of this because I have seen more than one case of isolated sixth nerve paralysis supposed to result from cold, and following exposure more or less definite, in which the subsequent course of the case showed that the sixth nerve paralysis was really the initial sign of some general condition—in one case disseminated sclerosis, in another tabes, and in yet another encephalitis lethargica. And when one considers how rarely, if ever, sixth nerve paralysis is associated with ordinary Bell's paralysis (facial paralysis)—admittedly the result of exposure to cold air, draught, &c.—it is hardly likely that sixth nerve paralysis, without paralysis of the seventh, often results merely from cold. Personally, I have never seen sixth nerve paralysis associated with ordinary facial paralysis, but as I have said I have frequently seen isolated sixth nerve paralysis as the initial sign of what afterwards became a widespread affection of the nervous system.

Isolated third nerve paralysis is a fairly common affection. In nine cases out of ten it is probably syphilitic in origin. It may occur without other signs of nervous disease and it may clear up completely under appropriate treatment. It may also occur in cases of tabes or general paralysis, and in these cases also it may completely disappear under treatment. In these cases it is to be assumed that it is the result of gummatous inflammation in the nerve sheath, for the presence of a chronic disease like tabes or general paralysis does not preclude the possibility of the development of manifestations of active syphilis. In some cases of intracranial growth third nerve paralysis is an initial sign, but it is not common to get this alone; other nerves are usually involved as well, and this will be easily understood when the anatomical relations, both of the nerve and its nucleus, are remembered. And it should be kept in mind that in some cases of pituitary tumour such paralysis is present although the classical signs of intracranial growth may be absent. I need only mention those curious cases of so-called "migraine ophtalmoplégique," cases of severe headache, usually one-sided, with paresis of the third nerve, which, under the influence of repeated attacks, become permanent paralysis. These cases are obscure in origin for they go on for many years and therefore may yield only rare post-mortem information. But in some, actual involvement of the third nerve either in growth or in infiltration has been found. Perhaps the most common affection of ocular movements is from a mixed affection of ocular nerves. Such an affection is common in diphtheritic paralysis. It is also frequent in encephalitis lethargica, but in some of these cases I am convinced that the affection is very slight and, when it is, it is usually transitory and the patient may make a complete recovery. Myasthenia gravis is a disease which frequently comes under the notice of ophthalmic surgeons and in this disease the ocular nerve affection is usually striking. It is striking because it is often so complete—double ptosis and almost complete paralysis of ocular movements. It is also striking because of its occasional, if temporary, complete or partial disappearance, and thus tragic mistakes have not infrequently been made of regarding such cases as "hysterical" because of this extraordinary variability. I think one cannot be too careful in regard to the diagnosis of hysteria in cases of ocular paralysis. In more than one instance I have known cases of myasthenia gravis mistaken for cases of hysteria and I have known the same mistake made with reference to cases of disseminated sclerosis in which ocular paralysis, sometimes of only one sixth nerve, has been the earliest sign. Graves' disease is one of those conditions in which weakness of ocular movements is frequently present. Sometimes this is very persistent, and I have known it present long after the characteristic signs of Graves' disease have disappeared. I have also known, although I think this must be unusual, a patient with Graves' disease come for advice because of diplopia without any complaint of other symptoms.

(II) VISUAL FAILURE.

I should now like to say a few words about those cases of visual failure which occur associated with widespread affection of the nervous system. Cases of impaired vision naturally seek advice at an eye hospital, and if there are any here who did me the honour to come to my out-patient clinic when I was still seeing out-patients at Queen Square, they may remember the extraordinary number of cases of tabes and of general paralysis with optic atrophy who were attending there. I was fortunate to have these cases, for they were mostly cases referred to me by my colleagues at Moorfields. When I see a case of optic atrophy in a patient who has signs of tabes, loss of knee-jerks and lightning pains—perhaps only lightning pains—and without ataxy, I am always apprehensive that such a patient will sooner or later develop the signs of general paralysis. I have seen this so often that I perhaps needlessly anticipate it. For such a development is not invariable. The case may really be one of tabes, but it is very remarkable how rarely ataxy is superadded, and the converse is true of ordinary cases of actual ataxy in walking—how rarely optic atrophy appears in such cases. But I think ophthalmic surgeons will agree with me that tabetic optic atrophy—so-called grey or primary atrophy—nearly always goes on to complete blindness, and usually in a very brief period of time. And this leads me to remark on the curious difference between this form of optic atrophy and that pallor of discs which is so very common in cases of disseminated sclerosis. I think it is now generally acknowledged that the cause of disc pallor in disseminated sclerosis is an antecedent retrobulbar neuritis. There is frequently a history of temporary obscuration of vision—the result doubtless of a patch of inflammation in the nerve behind the eyeball—but it is sometimes impossible to get a history of such temporary obscuration, and then one must suppose that the primary affection is very slight and of short duration. But disc pallor supervenes, usually much more of the temporal side of the disc, but not infrequently general in character. The striking thing to me is that in such cases you may often have extreme disc pallor with 6/5 vision. And in contrast to the optic atrophy of tabes such atrophy never proceeds to blindness. At all events I can say that I have never seen a patient with pale discs in disseminated sclerosis completely blind. I have known blindness in one eye following an unusually severe attack of retrobulbar neuritis, but blindness of both eyes never. And one has also to remember that optic neuritis may be present in disseminated sclerosis—no doubt identical in causation with the neuritis which does not show itself at the disc, and in rare cases this may be the only obvious sign of the disease. I can recall a case sent to me by Mr. Lawford with slight optic neuritis in each eye. The patient was a young lady of good physique, and living under very healthy conditions, who had sought his advice because of some impairment of vision. The only other sign of nervous disease when I first saw her besides the optic neuritis was an extensor response from one sole, but within eighteen months she had developed all the classical signs of disseminated sclerosis, and she died less than two years from the onset of her eye trouble.

I need only just allude to that curious fact, now I think familiar to all of us, that optic neuritis is so often present, even in cases of intracranial tumour without any detectable impairment of vision and without any complaint of visual failure on the part of the patient. It is a fact, I think, of immense importance and of great interest, and its recognition is perhaps the most valuable contribution made by a physician to ophthalmology.

(III) Defects in Fields of Vision.

I should now like to say a few words about the defects in visual fields which are probably equally familiar to ophthalmic surgeons and physicians, although I am bound to say that physicians do not seem to be quite so quick at recognizing their existence, possibly because they are not so familiar with their importance. I remember on one occasion sending into hospital a patient who had been suddenly seized with weakness of the left leg and left arm, and who had also, I found, left homonymous hemianopia. After her admission to hospital I saw her with the house physician. By that time the weakness of the arm and leg had almost passed off, and the house physician with due diffidence, I must say,suggested that the condition had been, and was, a functional one. I asked him: What about the fields of vision? He had not thought of them, and I was easily able to convince him that definite homonymous hemianopia was still present, and I may say that in this patient this still persists, although it is now several years since her attack. And this leads me to remark how rare it is for hemianopia to disappear. I have seen two cases in which complete clearing up of homonymous hemianopia took place. One was the case of a girl, aged 15, sent to me by Mr. Percy Flemming, in whom hemianopia appeared after an attack of scarlet fever. We both verified the presence of the condition, but Mr. Flemming saw her about a year later and found that it had entirely disappeared. The other case was one sent to me by Mr. Fisher. This was an old but very clever lady, who had not only left hemianopia but also had repeated slight Jacksonian fits, and who remained in a precarious condition for several weeks. The fits ceased, but the hemianopia was still present when they had gone, but this also finally cleared up completely, although the clearing up was preceded by curious hemiopic hallucinations, such as have been described in some cases. The hallucination in this case was of a little girl looking over the patient's left shoulder as she read—a definite but pleasant hallucination in her blind fields. This gradually faded away, much to the patient's regret, as the field was restored. I may mention in explanation of her regret for the pleasant lost hallucination that this lady was the happy mother of many daughters and of several sons. She lived for several years in good health after this attack.

I think it is very important to be on the outlook for quadrantic or other sectional defects. They are quite easily missed, at all events by physicians, and I have known cases in which the visual difficulty complained of by patients was put down to "liver" or some equally vague cause—cases in which careful examination with the perimeter would have revealed the presence of a partial homonymous field defect.

I need only briefly refer to the field defects in pituitary cases. It is strange how often a patient with temporal hemianopia in one eye presents himself when the other eye has become completely blind. It is to be presumed that the patient has only discovered the visual trouble when one eye has become blind or the seriousness of whatever visual inconvenience has been experienced has not been earlier recognized. But we can often obtain from such a patient a clear history that the nasal field of the now blind eye had been present when the temporal field had gone. X-rays now help us greatly in reference to the diagnosis of such cases. I need not refer to other features in the symptomatology of these cases, but I think many of you must have been struck as I have been with the curious variability in their response to treatment by glandular extracts. I have known more than one case in which extraordinary improvement has taken place after treatment with thyroid. I have known others in which pituitary extract has been equally efficacious and Mr. Fisher has told me of a case in which first thyroid and subsequently, after a relapse, pituitary were efficacious in clearing up the symptoms. The question of operation in some of these cases is an extraordinarily difficult one. If there is any chance of the condition being cystic, then operation has some chance of success; if it is a glandular hyperplasia then treatment by organic extracts would be called for, and operative measures would probably be unsuccessful. Yet if the patient were in urgent pain as in some cases I have seen, I should feel strongly inclined to advise an exploratory operation in the hope of giving at least relief.

It is rather remarkable in these cases how rarely optic neuritis is present. It is nearly always a primary atrophy, I suppose from pressure. Personally I have only seen one case with symptoms of pituitary tumour with optic neuritis—a case I saw a good many years ago through the kindness of Mr. Richardson Cross, and this patient I understand afterwards became quite well.

It would be fascinating to go on and consider the suggestions recently made by Mr. Fisher as to the connexion between Leber's atrophy and pituitary changes. Some of you may remember that I brought forward some evidence which seemed to lend support to his view. It would be interesting also to consider his somewhat revolutionary ideas as to the causes of migraine, although I think any evidence I would offer in regard to this would certainly not support his very original view on this subject. But I feel I have said enough and in conclusion I would only venture to express the hope that physicians and ophthalmic surgeons during this session of our Section may learn much from each other.

On the Intra-ocular Blood-vessels of the Ox.

By PRIESTLEY SMITH, F.R.C.S.

(ABSTRACT.)

Mr. PRIESTLEY SMITH exhibited a series of microscopical preparations and lantern slides showing the distribution of these vessels in different parts of their course through the eye. He was indebted for the greater part of his material to Mr. Frederick Lowe, of Wednesbury, without whose generous help and exceptional skill in photography and in the injection of minute blood-vessels the investigation could not have been carried out.

His original purpose was to obtain such data as to the number and size of the intra-ocular vessels in different regions as would indicate how the fall of pressure which occurs between the entrance-points and the exits is distributed—i.e., how much occurs in the arteries, how much in the capillaries, how much in the veins. The purpose on this occasion, however, was simply to exhibit some of the material obtained so far. The conclusions to be drawn therefrom would be published later, in continuation of certain earlier papers on intra-ocular blood-pressure, in the *British Journal of Ophthalmology*.

The following points among others were noticed: Certain differences between the ox eye and the human eye—viz., the wide divergence of the anatomical axes; the power of binocular fixation in spite of this; the wide extent of the visual field backwards; the tapetum lucidum. The different arrangement of the ultimate vessels in the tapetal and the non-tapetal parts of the choroid. The highly convoluted character of the vascular membrane forming the ciliary processes, the complexity being much greater in the large eye of the ox than in the small eye of the rabbit because the volume of fluid to be supplied to the chambers varies, probably, not with the diameter of the eye but with the cubic contents.

The details of the subject cannot be profitably discussed until many of the preparations have been reproduced for publication.

Mr. J. B. LAWFORD said he had had an opportunity, some months previously, of seeing many of the specimens now exhibited, at Mr. Priestley Smith's house, and it was a pleasure to him to see them again on the screen. He suggested that it would be a graceful act to send a message of appreciation and thanks from the Section to Mr. Lowe, who helped so admirably in the preparation of the specimens, with a word of congratulation on the success of the work. Mr. Lowe was a hard-working man, who had to earn his own living, and he had given his help purely as a labour of love.

This was agreed to.

Plexiform Neuroma.

By FRANK JULER, F.R.C.S.

J. H., AGED 15. History: Swelling of upper eyelids for many years, increasing recently.

Fibromatosis of both upper lids, right frontal region, right and left temporal fossæ, right occipital region. Plexiform trunks in upper lids, with increase in size of supra-orbital notches.

Pigmented patches in skin of trunk and thighs.

Right eye: Buphthalmos; horizontal diameter of cornea, 13 mm. sph. −5·5, cyl. −6·5. Fundus shows patches of myopic choroidal atrophy.

Left eye: $\frac{6}{36}$ 1 e; myopic, sph. −6, cyl. −6; cornea, 11 mm. diameter, tension normal. Pulsation in both orbits, L > R.

Evulsion of Optic Nerve.

By P. G. Doyne, F.R.C.S.

First seen at Cheltenham Terrace, July, 1920. He states that the right eye has always been defective, but that there was some vision in the eye until his accident in 1914. In December, 1914, he received a blow over the right side of the head; this made him unconscious, and he did not recover consciousness till in hospital. He was kept in hospital for four days. There was much bruising of the right eyelids and a cut on the right eyebrow. Since the accident the right eye has been blind. He says that the right eye used to turn in, but that latterly it has turned out.

On examination a scar is seen over the right eyebrow, and this eye diverges. Right vision, bare perception of light; left vision, $\frac{6}{6}$. The right pupil does not react to light. The right eye has about six dioptres of myopia. The left eye has normal refraction. On examination of the right fundus the disc is seen to be deeply cupped. At the bottom of the cup there is some organized exudate, which obscures the bottom of the cup; vessels can be seen extending down into the cup, but are lost to view under the exudate. Surrounding the disc there is an area of atrophy and pigmentation.

Section of Ophthalmology.

President—Dr. JAMES TAYLOR, C.B.E.

Case of Unilateral Leontiasis Ossia with Optic Atrophy.[1]

By N. BISHOP HARMAN, F.R.C.S.

A. M., A GIRL, aged 11, was seen in July, 1918. A defect of the right eye had been found on examination at school.

Right vision less than $\frac{6}{60}$, left vision $\frac{6}{6}$. Retinoscopy, right and left, −1 D. sphere. Right disc primary atrophy, no choroiditis. Examination of the field elicited some sense of light on the temporal side, and to a lesser degree on the nasal side. Colours could be seen in the temporal, but not in the nasal region. The fundus and field of the left eye were normal.

The child's teeth were honeycombed, and her head was asymmetrical. On the right side of the head were three large bony exaggerations of certain points: one just to the right of the metopic suture, a region not infrequently slightly accentuated in children; a second forming a distinct enlargement of the anterior part of the temporal ridge; a third on the parietal bone, just in front of the parietal eminence. The movements of the eye were normal. There was no exophthalmos. The child had not had headaches or neuralgia, and there was no history of illness. X-ray examination of the skull showed a massive thickening of the right side, mainly in the regions of the bony elevations and about the orbit. There was no deformity of the face or other part of the body. The Wassermann reaction was negative, the mother and sister were healthy.

Patient has been seen several times since 1918; only one change has been found—the right eye is now two or three millimetres more prominent than the left, but its movements are in no way affected.

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[1] At a meeting of the Section, held December 10, 1920.

There have never been headaches or pains about the head. She is well grown, healthy looking, cheerful, and full of vitality. Renewed X-ray examination this month has revealed nothing further.

DISCUSSION.

Mr. E. H. E. STACK said that in 1900 he had a remarkable case of leontiasis ossia, in a female patient, which affected the whole head, and had been slowly growing for twenty-one years. He was able to secure half the skull after death. None of the foramina of the base were even slightly affected, although the vault and the face were tremendously involved in the bossy diffuse leontiasis. At one spot the skull was 3 in. thick. There was no interference with brain or nerve function. She had long attended an out-patient department, and the case was regarded as hydrocephalus, which it resembled. The cause of death was diphtheria. The head was of enormous weight, and the patient had been accustomed to sit supporting it with her hands, so that in time her forefingers were dislocated outwards by the burden. He wrote to Dr. Keevil, of Michigan, who had described the condition, sending him photographs, and in reply Dr. Keevil pointed out that in advanced leontiasis ossia the foramina were not affected. It was difficult to imagine that in the present case the foramina had not been involved; one would have thought a slowly exerted pressure behind the foramen would not have affected the nerve.

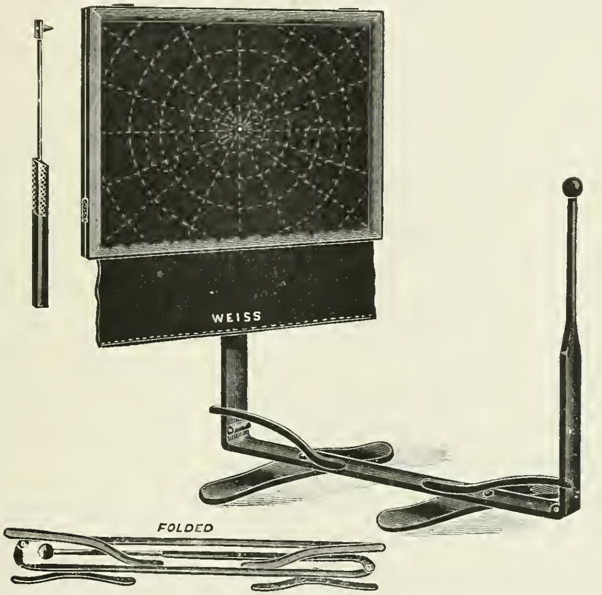
The PRESIDENT said the interesting feature of the case was the optic atrophy. He remembered only one case of this disease, that of a patient whom he first saw about twelve years ago, and had seen several times since. This patient used to travel to London yearly to get a larger hat, owing to the progressive growth of the skull bones; he too had felt the increasing weight of his head, and he was also deformed in several other ways. He had, however, no headache nor optic atrophy. The optic atrophy must be a very rare complication. How did Mr. Harman suggest the condition was caused?

Mr. BISHOP HARMAN, in reply, said he thought the optic complication was due to the optical bone sharing in the enlargement. The bone was very dense in character.

A Direct Record Scotometer.

By N. BISHOP HARMAN, F.R.C.S.

THE instrument shown is a simple and convenient arrangement for making and recording Bjerrum's test and mapping out central scotomata. I have used it for over two years, and find it a great labour-saving contrivance. Its real advantage consists in the speed and accuracy with which observations may be made and recorded. In this work speed and accuracy are synonymous. My observations have convinced me that to get accurate results the work must be done so quickly that the patient does not get tired or let his eye wander from the fixation point. If in making his records the surgeon has to move about, take notes, shift the instrument, or do anything which takes time or diverts the patient's attention, the accuracy of observation is seriously diminished, if not lost. I have taken a series of observations in measuring the blind spot of one of my own eyes, repeating the measurements time after time, without interval for rest. I have found that the fifth or sixth mapping gave a slightly larger area than the first, and after that fatigue made a delineation erratic.



The face of the screen bears no mark other than the central fixation spot; the dotted lines of radii and degree circles indicate the chart beneath the screen.

My first experience of Bjerrum's test was made as recommended by its author, with a black sheet hung against a wall. I soon felt the need of getting behind the screen so as to be able to see the patient's eyes without interruption. I thereon used a blackened disc of three-ply wood fitted to the ordinary perimeter stand with the degree circles and radii graven upon its surface. The object used was gummed on to the point of a lead pencil, so that its movements could be recorded by the marks of the pencil on the blackboard. The method was quick and accurate, but had the serious disadvantage that the record needed copying on paper, a duty occasionally forgotten. After that I tried thin sheets of tracing paper fastened to the blackboard, so that the paper received the direct record of the observation. But this had to be discarded, for the patient saw what was being done. One patient brought me a sheaf of observations of his blind spots which he had made himself; it is not desirable that neurotic glaucomatous patients should become habitual "field-takers." Wishing to take the record on black paper, I used a handy piece of typewriter carbon, and thus the form of recorder you see came about.

The idea of a carbon paper recorder occurred to Mr. P. H. Adams, of Oxford, during the Oxford meeting of this year, but learning that I had the scheme in actual working he left the matter to me. At the November meeting of this Section of the Society, when I gave a demonstration of this instrument, Dr. Gordon Holmes informed me that he had got a direct record of scotomata by pricking through the screen on to paper behind it with a fine needle, and that he had mentioned this to the Society when reading his paper. The carbon recorder has some advantage over the needle, for it is easier to work, the slight pressure required with the carbon is quicker than a needle prick through two tissues; but the real advantage is that with the carbon paper a continuous record of the movements of the object may be made throughout the observations by lightly dragging the pointer over the screen and pressing it upon the screen to make heavier marks at salient points.

The screen is fixed to a stout iron frame. This can be shut down when not in use, but it is rigid when set up. There are no loose pieces, screws or joints to be fitted together. The screen is of a dark grey cloth mounted on a wooden frame; chart and carbon are slipped behind the screen and the whole clamped in the frame. The frame slips on to the higher of the two uprights of the stand. The other upright ends in a ball, against which the patient presses the side of his nose close to the cheek: he holds this upright with one hand, and covers the eye not under observation with the other. The fixation spot is marked on the screen by a white metal stud fixed into the cloth. The position of the blind spots is marked at the back of the frame by two knobs, one or other of which the surgeon holds as a guide, so that no time is lost in finding the working areas. These knobs are most useful; they give such a sense of position that after a little experience it is possible to keep one's eyes fixed upon the patient's eyes during the whole series of observations, the feel of the knob at the back of the frame giving sufficient guidance for the movements of the object-holder in the other hand.

The surgeon stands behind the screen, holding a knob with the left hand; his right hand is enveloped in a dark cloth bag, and the object-holder projects from the hand through a hole in the bag. The object-holder is a rod fitted in a convenient handle to be held pen fashion. At the free end of the holder is fitted a small carrier with the object; at the back of this is fixed a blunt pointer which is moved over the face of the screen and pressed upon it when desired.

The chart measures 13 in. by 8 in.—i.e., it is foolscap size, which at 33 cm., gives a range from the fixation spot of 26° laterally and 17° vertically. The shape of the chart is determined by the size and shape of the typewriter carbons, which are only made in certain sizes. I have found this chart of ample size, giving all the range that is required for such observations. The large scale allows the same sheet to be used for several examinations of one patient at different times; differently coloured carbons are provided to distinguish the records; by this means valuable comparison is obtained.

The working distance of 33 cm. is that of our best known arc perimeters. I find no advantage in a longer working distance, but a shorter one is liable to introduce complications by reason of the shadows from the patient's head.

A Trial Frame with Unilateral Vertical Adjustment for the Correction of Hyperphoria.

By N. Bishop Harman, F.R.C.S.

We may correct hyperphoria by prisms or by the disassociate vertical decentring of spherical lenses when these are worn. There is also an artificial hyperphoria produced mainly in near work when anisometropia is corrected. To measure directly the vertical decentring of lenses needed to correct true hyperphoria is not easy, it is still less easy to correct the decentring of lenses of unequal strength in near vision. In 1910[1] I showed a pattern of ophthalmic callipers, one limb of which gave a T-square with a vertical scale adapted to measure the decentring when the trial frame is tilted so as to carry the lenses of one side up or down until the required balance is obtained. Tilting the frame has the disadvantage of putting cylindrical lenses out of focus, so that accuracy of balance cannot always be obtained. To overcome this difficulty I have had a trial frame fitted with unilateral vertical adjustment. The frame is of the Moorfields pattern with the usual facial, lateral and vertical adjustments worked by screws. To the limb which carries the lens cell of the left side a separate vertical adjustment has been fitted. The limb is telescopic and worked by rack and pinion, so that the lens cell can be moved vertically upwards or downwards 5 mm. each way. The vertical displacement of the lenses necessary in any case to obtain an even balance of the eyes may be read off from the scale engraven on the telescopic limb.

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[1] *Trans. Ophthal. Soc.*, 1910, xxx, p. 56.

Case of Leprosy affecting the Conjunctiva and Cornea.

By HUMPHREY NEAME, F.R.C.S.

AFFECTIONS of the eye due to leprosy are extremely rare in this country. The last cases to which I can find reference were shown and described by Mr. Treacher Collins [1] before the Ophthalmological Society in 1909. The patients were father and son, aged respectively 45 and 15, of Polish nationality. In them there was a factor of still greater rarity in that the onset of the disease occurred in this country. The father had left Riga twenty years previously and had noticed nothing amiss until five years before. The boy had only had the disease two years and was much the more severely affected. In these cases the father had presumably acquired the infection fully fifteen years before, and infected the boy at a date subsequent to its appearance in himself. The great length of the latent period is not uncommon. Lie [2] cites, among others, a case in which the disease appeared in a woman twenty-seven years after her leprous sister had left her.

In connexion with the consideration of the occurrence of leprosy, an interesting fact was disclosed by Lie four months ago at a meeting of the Norwegian Medical Association. Sixty-two years ago there were 3,000 cases of leprosy in Norway. In 1918 there were only 180 cases. One wonders whether this fact, with the assumption that the Norwegian is still largely a fish-eating race, would have caused the late Sir Jonathan Hutchinson to modify his theory on the spread of the disease.

The infection in the present case occurred either in East Africa or in India, in both of which countries this patient has spent many years. The first thing he noticed of the condition was about eight years ago, when some spots appeared on his arms a short while after a swelling on his right forearm had been cauterized. He was ignorant of the diagnosis, until this year. On account of his eye condition he was sent to Mr. Mayou, who handed him on to me.

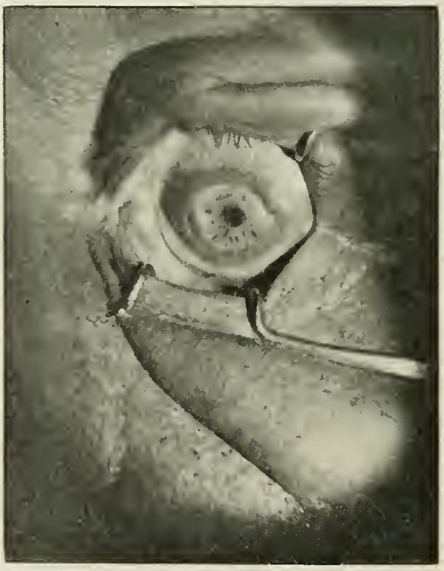
Clinical and Pathological.—The case is of the nodular type of leprosy. There is the so-called leonine expression, due to the thickening of the skin of the cheeks, forehead and nose, and the deepening of the furrows. There is deficiency of the eyebrows. The eruption extends widely over the body. Individual patches show a typical early nodular condition. The nodules are of various shapes and sizes, and of a yellowish colour. The skin is raised and tethered to thickened subcutaneous tissue. Hands, arms, face and trunk are widely affected, the legs not so extensively. Although there is some diminution of tactile acuity in the raised patches, I could find no definite areas of anæsthesia, and no distinctly nodular nerves. The ulnar nerves are readily felt, but are not unduly large considering the man's build.

Coarse tremor of hands, more distinct since the last intravenous injection. Reflexes: Pupils fixed; knee-jerks brisk.

The patient's voice indicates nasal obstruction, and there is a sanious nasal discharge. Abundance of *Bacillus lepræ* were obtained from abrasions in the nasal mucous membrane by Dr. W. E. M. Armstrong.

The eye: The lids and surrounding skin are infiltrated and œdematous. This œdema was very much increased after the last injection, but is now subsiding. Borthen and Lie [3] disagree with a statement in the Graefe-Saemisch handbook, that the lids are among the earliest parts to be affected in leprosy; they think this is usually a development and always by extension from surrounding skin.

Conjunctiva: There is here what one may regard as an early nodular condition, most evident in the part immediately surrounding the cornea. The conjunctiva is raised up by subconjunctival infiltration, and to some extent overhangs the peripheral part of the cornea, particularly in the upper and outer part of the left eye (here illustrated, p. 18). It is of a yellowish colour, with many very fine vessels which give it almost an orange tint. The stereoscopic photograph shows very clearly the way in which the conjunctiva is raised up into a fold partly overhanging the cornea. In the right eye I excised a strip of the conjunctival tissue at the upper margin of the cornea. This was shown under the microscope; one section, stained with hæmatoxylin-eosin, demonstrates the slight degree of cellular infiltration in the thickened tissue. In the leprous nodule there is a much less marked cell-infiltration than in the granulomata of syphilis or tubercle. The other section, stained with carbol-fuchsin, showed the acid-fast bacilli in numerous groups in the subconjunctival tissue. My first inclination on seeing this extraordinary appearance—literally thousands of bacilli—was to ask "Is this an artefact? Surely this is a new crystalline formation of the fuchsin?" The same condition holds in the skin nodules of leprosy, and obtains in the material removed from the ulcers in the nose—everywhere overwhelming abundance of bacilli. Lie found the bacilli in small numbers in the epithelial cells of the conjunctiva, with epithelium that lacked well-shaped cubical or cylindrical cells in the deeper layers. He also found a few in the endothelial lining of spaces in the conjunctiva, either blood or lymph vessels.



The vascularity of the conjunctiva was much increased in this patient a few days after the last and largest injection and was accompanied by some increase of œdema of the conjunctiva as well as distinct swelling of the lids. There was not however any of that extreme localized congestion of the conjunctiva near the corneal margin, shown in some of the illustrations in Borthen and Lie's book. Such localized circum- or infra-corneal congestion is discussed at length in that book, and is shown to be associated with intra-ocular disease, iritis or cyclitis. This will be referred to later.

Cornea: The cornea in this case shows a definite haze extending from the margin, most evident, in each eye, in the neighbourhood of the greatest swelling of the conjunctiva. With the loupe it is seen to be a fine grey-white stippling. None of this can be described as nodular, it is too fine.

Iris: The pupils are small and fixed. They were not dilated in forty minutes by several applications of 2 per cent. homatropine and cocaine, and remained circular. There is a projecting point of pigment from the margin of the right pupil.

Vision: Right, $\frac{6}{18}$ (3); +2·0 sph. = $\frac{6}{12}$ (4). Left, $\frac{6}{36}$; + 2·0 sph. = $\frac{6}{18}$; no improvement with cylinders. With presbyopic correction, = J1, 12 in.

Uveitis: To help us decide whether there is uveitis in this case, the following points must be considered—(1) There is no well-marked circum-corneal congestion as figured by Borthen and Lie; (2) Is the keratitis parenchymatous, or only superficial?; (3) the state of the pupils; (4) the vision. I should like to hear views on this matter of uveitis.

I will not further discuss the pathology, which has been dealt with fully by Parsons [7].

Treatment.—This patient had eight intravenous injections of sodium morrhuate, at about three-day intervals. Doses of from 1 c.c. to 3 c.c. were given of the intravenous preparation. There was never any apparent reaction. Four intravenous and subcutaneous injections of sodium chaulmoograte have so far been given, and there was no reaction until the last dose of 4 c.c. Martindale's preparation. Two days after this dose the patient felt ill, and went to bed again. The left eyelids and conjunctiva became more swollen, and the conjunctiva became more inflamed. A blood blister developed on the side of the right foot, and a few days later some small bullæ appeared on the dorsum of the right hand, on a leprous area. These bullæ may perhaps be merely a leprous manifestation, as they do occasionally occur in the macular and anæsthetic type of the disease [4].

Walker and Sweeney [5] found that the sodium salts of the total fatty acids of chaulmoogra oil were active against acid-fast bacilli in dilutions of from 1 in 100,000 parts to 1 in a million, and not against other organisms. Rogers [6] claims that, in a series of cases of leprosy treated with these salts: 50 per cent. of cases of less than three years' duration of disease lose all signs of their lesions and become bacteriologically negative; 25 per cent. of cases of between three and fifteen years' duration of disease are similarly cured. The theory of action is that the acid-fast bacilli use some of the fatty-acid of the chaulmoogra in the building up of their fatty capsule, and that this capsule therefore contains something toxic to the bacillus.

Another recent form of treatment that has been tried in Durban by F. G. Cawston [8] is intramuscular injection of colloidal antimony (oscol stibium). In two cases reported, as few as four and six injections respectively appear to have cured ulcers and to have removed all signs of leprosy. It is unfortunate that bacteriological examinations do not appear to have been carried out at the commencement of treatment in these cases. After treatment of the first case a negative bacteriological result was obtained from a swab from the nose.

The patient seems hopeful, and thinks that some of the patches on his arms and legs have diminished. I cannot say that I have observed any definite improvement up to the present. He is staying in England two more months, and I propose to continue treatment with sodium chaulmoograte if his system will tolerate it. He is, happily, quite an optimist; as a result of his feelings after the last and largest injection, he said, " Something's got to happen. Either 'It' goes or I go."

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DISCUSSION.

Mr. E. TREACHER COLLINS said he had seen three cases of ocular leprosy. The first was a man from Rangoon, who had a completely opaque cornea on one side, and commencing parenchymatous keratitis on the other, together with nodules at the sclero-corneal margin, very much as in the present case. The patient had had a peritomy done on the first eye, and thought the operation had delayed the progress of the disease in the cornea. Mr. Collins was therefore asked to do a peritomy on the other eye. He did so, but it did not check the spread of the keratitis. He cut sections from the conjunctiva which was removed, and he could confirm what Mr. Neame said with regard to the appearance of the bacilli. The large number of red points which he first thought were artefacts were really masses of bacilli. The opacity of the cornea in this disease always remained permanent, thus differing from that of interstitial keratitis of syphilis, which cleared up. Keratitis was the most common cause of loss of sight in tubercular leprosy. He thought it must be easy to diagnose ocular leprosy from the clinical appearances because having seen the case he mentioned he recognized it at once in two patients who came from Cork to consult him, a place in which one would not expect leprosy to develop. They were father and son; the latter was born in Cork, and must have acquired the disease from his father, who probably brought it with him from Riga. These cases he showed in London and at Oxford. They did not improve under treatment, and Mr. Collins did not know what ultimately became of them. The father went about London, and was shaved in several different barbers' shops, obviously a dangerous proceeding. In leprosy the disease always seemed to be confined to the anterior part of the eye and gave rise to no ophthalmoscopic changes.

Mr. M. S. MAYOU agreed as to the ease with which such cases could be diagnosed if suspected; the nasal mucous membrane seemed to be nearly always affected, and by making a smear preparation of the discharge from that, quantities of the bacilli could be found.

Mr. GRAY CLEGG said he had received a letter from Dr. Caleb Davies, a medical missionary in India, saying he had used sodium gynocardate with success in the treatment of leprosy. Dr. Davies had suggested the use of sodium morrhuate for tubercle of the eye. Mr. Clegg had used it in a case of distinctly tuberculous iritis. The tubercles disappeared in a remarkably short time. A second case of the same nature did not clear up so rapidly. Treatment along these lines might lead to the cure of tuberculosis.

Mr. TRAQUAIR said ocular manifestations in leprosy must be relatively rare. From a careful examination of the present case he thought iritis was present. Near the pupillary margin there were white, glistening points, and he wondered whether these were peculiar to leprosy; he had not seen the same appearance before. He could support Mr. Mayou's remarks as to diagnosis, but had found it even simpler to prick one of the nodules on the skin, press the exudate on to a slide and stain it by the Ziehl-Neelsen method. The enormous number of the bacilli and their characteristic "bundle-of-cigars" arrangement could often be well shown in this way.

Mr. NEAME (in reply) said the ease with which the organisms were found had surprised him: the preparation of organisms from the nasal mucous membrane was made by Dr. Armstrong, of the Central London Ophthalmic Hospital. He agreed with Mr. Traquair that there was some iritis, owing to the small fixed pupils, and he saw a projecting piece of pigment in the right iris. When the disease affected the iris he thought it was usually in the form of nodules.

Persistent Pupillary Membrane with Opaque Nerve Fibres in both Eyes.

By Norman B. B. Fleming.

M. V., female, aged 15. History of defective vision since birth. Right eye: Pigmented lace-like plaque adherent to anterior surface of the lens; no strands passing to the margin of the iris; a few opaque nerve fibres. Left eye: There is a plaque similar to that in the right eye, but stretching to the margin of the iris there are many fine pigmented strands, disposed chiefly at the lower part. The fundus shows many opaque nerve fibres.

A special feature of this case is the absence of the normal iris pattern. She has 2 D. of myopia in each eye, but, in spite of this and the condition above described, her vision is $\frac{6}{18}$.

Mr. E. Treacher Collins said the absence of pattern in the iris in this case was a very interesting feature. The iris grows in beneath the anterior fibro-vascular sheath of the lens, which may be divided into an iritic portion which subsequently covers the surface of the iris and the portion which remains over the pupil and forms the pupillary membrane. In the present case there seemed not only to have been a persistence of the pupillary portion, but also some persistence and thickening of the iritic portion which obscured the details of the surface of the iris. Similar cases had been recorded by Coats and Marcus Gunn some years ago.

Implantation Cyst of Iris.

By M. L. Hine, M.D.

M. P., female, aged 23, first attended the Royal Westminster Ophthalmic Hospital on February 2, 1908, when aged 10, with a penetrating wound of the left cornea at the limbus, about 5 o'clock, caused by a cut on the eye from a child's nail. An iridectomy was performed.

On October 21, 1908, the patient returned with a "small pearl cystic body along the lower margin of the coloboma."

I first saw her in November, 1915, when she came to the hospital again, complaining of headache after reading, for which weak plus cylindricals were ordered. The cyst was noted, appearing just as now seen, and there is also a note at that time that it was not increasing. In October, 1919, she was seen again, and note made: "Cyst as before."

She reappeared again in November, 1920, with condition unchanged.

Present state: Right vision, $\frac{6}{6}$; right and left tension normal. Left vision, $\frac{6}{12}$ $\bar{c}$ +0·25 sph., $\bar{c}$ +0·5 cyl. ax. 100° = $\frac{6}{6}$, three letters. Scar at left limbus at 5 o'clock. Narrow coloboma of iris, extending up and in to pupillary margin. On lower margin of coloboma is a pearly white cyst, measuring about 4 mm. by 2·5 mm., with a small black speck of iris pigment on its surface. The edge of the lens and the suspensory ligament are well seen in the coloboma. Cyst translucent.

This case is shown on account of the long time the cyst has been under observation. The vision in the eye is good and the tension normal, while no increase in growth of cyst has been noted for twelve years. There is obviously no necessity for operative interference, which would only enlarge the narrow coloboma and probably impair the present good vision by producing a greater dazzling effect. It is interesting to compare it with Mr. McMullen's case.

Implantation Cyst of Iris.

By W. H. McMullen, O.B.E., F.R.C.S.

H. J., MALE, aged 18, attended the Royal Westminster Ophthalmic Hospital October 19, 1920, complaining of inflammation of the right eye.

History: Eight years ago he injured his right eye by running into a bush. He was laid up with it for six weeks. It gave no further trouble until May, 1920, when he had an attack of redness, aching and lacrymation, lasting two or three weeks. He then, for the first time, noticed a dark mark in the eye. It became red and painful again the day before he came to the hospital.

Condition when first seen: The conjunctiva of the right eye, both palpebral and bulbar, was injected. There was a cyst in the upper temporal part of the iris occupying the periphery of the anterior chamber from 8.30 to 11 o'clock. The cyst was translucent, its wall being very thin and its contents clear fluid. Attenuated iris tissue could be made out on both its anterior and posterior walls. The tension was normal (Schiötz tonometer readings: Right eye, 16 mm.; left eye, 18 mm.).

Present condition: Redness and pain have gone; the appearance of the cyst is unchanged.

The appearance of this cyst is very similar to that of one I showed at the June meeting this year, which I regarded as a serous cyst, but which Sir William Lister suggested might be an implantation cyst due to unnoticed injury in early infancy. In view of the definite history of injury it appears most probable that the present case is an epithelial implantation cyst. Complete removal appears impracticable. Partial removal would almost certainly be followed by re-formation of the cyst, or, possibly, spread of epithelium over the walls of the anterior chamber leading to the condition of cyst of the anterior chamber. I propose, therefore, to leave it alone so long as it causes no trouble.

DISCUSSION.

Mr. MAYOU said he had had two of these cysts to examine which came to him in the pathological department. In one the anterior wall of the cyst had been removed in the ordinary way with iris forceps and scissors, and the cyst collapsed; but two fresh cysts formed at the margins where the two edges of the cyst fell together. These were removed, and the patient developed very bad irido-cyclitis, and went out of the hospital against the surgeon's wishes. She subsequently developed sympathetic trouble in the other eye, and became nearly blind. Much the same sort of occurrences followed in the other case, the eye being eventually removed.

Mr. GRAY CLEGG said he had once attempted removal of a cyst of the iris. It collapsed after seizure of the anterior wall and it was impossible to dissect it out. About three weeks later the appearance was much the same as before. There was a remarkable difference in the two cysts shown to-night. In Mr. Hine's case the posterior layers of the iris were very thick, but in Mr. McMullen's the anterior and posterior walls were very thin, so that transillumination showed up the affected area almost as bright as the pupil.

Mr. HINE (in reply) said that, from the discussion, it was evidently unadvisable to interfere in cases of cyst of the iris, unless the cyst definitely increased in size, or the tension of the eye was raised.

Section of Ophthalmology.

President — Dr. JAMES TAYLOR, C.B.E.

Foreign Body retained in the Eye for Many Years.[1]

By G. WINFIELD ROLL, F.R.C.S.

PATIENT, a male, J. C., aged 38. Right eye, foreign body in fundus. When I first saw the patient the foreign body was located up and out in the eye, and the late Sir James Mackenzie Davidson took a skiagram of it, which I still possess, and it shows a minute foreign body. The man was at work with steel implements, and a tiny fragment of the metal entered his eye. I did not see the man until some weeks after the accident. Up and out from the macula there was an oval spot, greenish-white in colour and rounded, longest diameter about $\frac{1}{2}$ D.D. His vision was then $\frac{6}{6}$; there were no corneal nebulæ, and the media were clear. There is now a tiny nebulous spot in the neighbourhood of the limbus. The man has been exposed to that kind of thing all his life; he is employed in Woolwich Arsenal. I decided that it was not a case calling for interference, mainly because the foreign body was encysted, vision was good, and the eye was quiet some weeks after the accident. I have seen the man from time to time ever since; the vision is now $\frac{6}{18}$, but the eye gives no trouble. There is no macular change and no siderosis. The only alteration in the ophthalmoscopic appearance is the development of an area of atrophy below the foreign body, and there is a slight deposit of pigment in the same locality, with a few vessels, which are either remnants of those of the choroid, or collaterals. The retina below is slightly raised. The other eye is normal; there is some loss of visual field on the nasal side, but this is very limited. The *American Journal of Ophthalmology* mentions a case in which a foreign body remained in the eye twenty-nine years without causing much trouble. There does not seem to be any reason why a foreign body should not stay an unlimited time in the globe provided it is small and aseptic, so that it does not wound the ciliary body or involve the iris. In the present case neither lens nor iris were passed through by the foreign body, and it is questionable whether the cornea was wounded at the time of the accident eighteen years ago.

DISCUSSION.

Mr. W. T. HOLMES SPICER said it was possible that the changes in the neighbourhood of the foreign body in the choroid were due to its presence in the eye. A condition known as siderosis sometimes ensued from a metal foreign body being in the eye: in this case there was probably a local siderosis. Sometimes the whole eye turned a rust colour owing to infiltration of all the eye tissues with salts of iron. After eighteen years' presence of the foreign body in this case he thought Mr. Roll might well feel confident in leaving it alone. He had a case in which a man, employed in some works at Swindon, had a rupture of the sclerotic from a blow by a piece of metal. He was taken into Moorfields, in October, 1909; the wound was sewn up by the house surgeon: when he left the hospital his vision was $\frac{6}{6}$, and remained so till October, 1911. The sight then began to fail, there were large floating webs in the vitreous, and a rusty colour of the iris; the colour gradually got darker, and the iris became brown and hazy, the other iris being blue. The eye was then enucleated, as it was not thought safe to keep it, and it was useless. All the tissues of the eye had the same rust-brown colour.

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[1] At a meeting of the Section, held January 14, 1921.

Mr. ROLL (in reply to questions by the President) said that vision had been $\frac{6}{6}$ several years. There was no macular change, and the media were clear. There was a slight elevation in the neighbourhood of the foreign body which possibly might be the beginning of some detachment. The man said that at the time of the accident he was blinded for a week. This was succeeded by vision through a veil of gauze. When first seen this had disappeared.

A Case showing Discs with Large Intramarginal Cups without, as yet, any definite Symptom of Glaucoma.

By A. HUGH THOMPSON, M.D.

IN the right eye the cup occupies three-quarters of the disc diameter; in the left eye five-sixths, leaving on the temporal side only a very narrow ribbon between margin of cup and margin of disc.

The patient was first seen on June 10, 1920. She came for glasses, being 52 years old. On that occasion her vision was $\frac{6}{12}$ each eye. On dilating the pupil I found slight peripheral lens opacities, hypermetropia +1 in each eye, and discs as they are now. Tension was normal, and the visual fields were normal. Now (January 10, 1921), the condition is practically unchanged. Vision: Right, $\frac{6}{12}$; left, $\frac{6}{9}$. The eyes get misty sometimes, but she never sees rainbow colours. Tension normal. With undilated pupils no lens opacities can be seen. The visual fields are full except for slight peripheral contraction on the temporal side (to 70°) in the left eye. Each blind spot (tested with McHardy's perimeter and a 5 mm. square) has a diameter of about 7°, but there is apparently no scotoma beyond that limit. I believe that this case is on the way to glaucoma.

Coloboma confined to Optic Disc.

By J. HERBERT PARSONS, F.R.C.S.

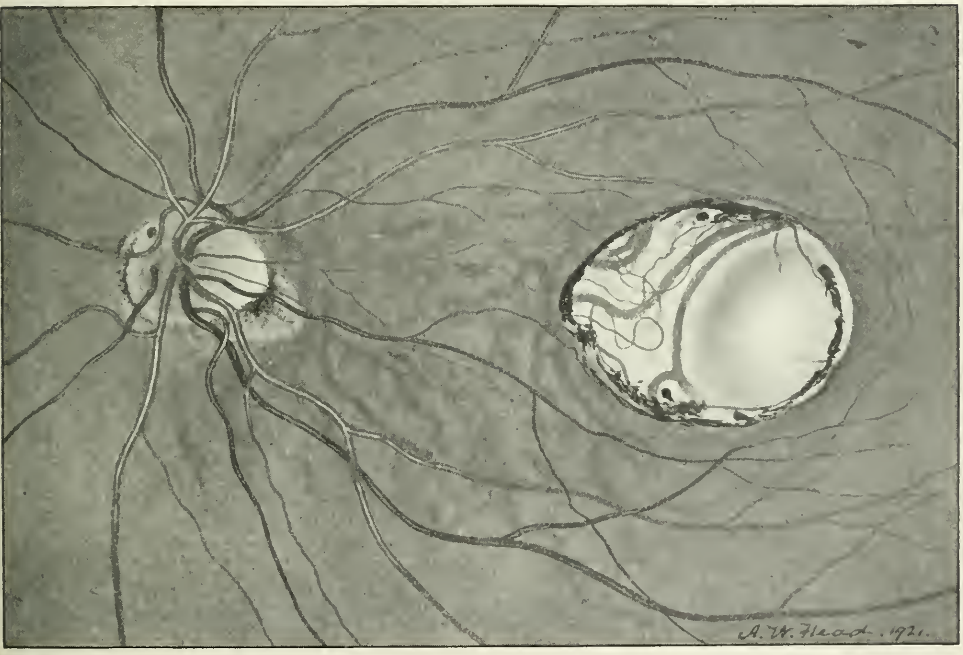
(Shown for R. LINDSAY REA.)

PATIENT, a female, aged 17. Vision: $\frac{6}{9}$; $\bar{c}$ + 2·00 D. sph., vision $\frac{6}{6}$. Normal field of vision; no scotoma. Coloboma confined to disc. Caspar's third division (re-distribution of vessels). Coats' Group III (coloboma).

Case of Coloboma of the Macula.

By MALCOLM L. HEPBURN, F.R.C.S.

IN my opinion, this is a case of a coloboma of the choroid in the macular region. It is difficult to justify the term "coloboma of the macula," but if ever there was a case of the kind I think this is one. By coloboma I mean failure of development of the choroid at the macula. Many cases have been shown, described and drawn as coloboma which I do not think have been coloboma at all, but simply old inflammatory scars of choroiditis. The points in which the present case differs from those cases of inflammation are the following: It has a pearly-white centre, with a definite ectasia on the temporal side of the patch, and there is a border of pigment round its edge, in the same way as one sees a slightly pigmented border round a normal disc, because the choroid stops short at the edge of the disc, and a similar pigmented border is seen in coloboma of the choroid in the usual situation, where the choroid stops short at the point where it has failed to develop. If the present case were an inflammatory patch, I think there would be more pigment proliferation than is here to be seen. True coloboma of the choroid at the macula I consider very rare.



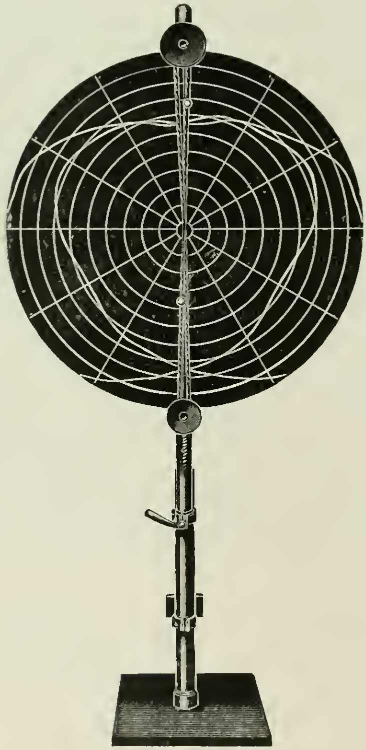
Demonstration of Instruments enabling a Class to Examine the Fundus of the Eye and to take Photographs of the Interior of the Eye.

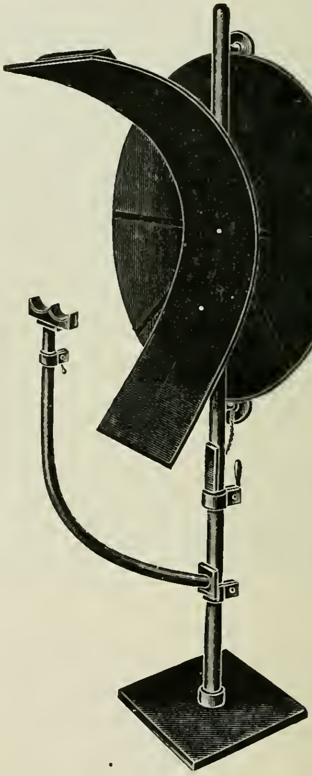
By Professor SALOMONSON (Amsterdam).

THE optical modus operandi was explained by a series of photographs demonstrated by means of the epidiascope. Polarized light passing into the eye was de-polarized in the retina and sent back in the ordinary state. To counteract the incidental reflections which interfered with the clarity of the image, he employed Nicol prisms, aided by a very small diaphragm placed at the intersecting paths. In the photographic instrument the reflections on the ophthalmoscope lens were eliminated in a different way. He showed actual untouched photographs of choked disc, with tortuous vessels, diabetic retinitis, multiple sclerosis of brain and spinal cord, tumours of the retina, and sclerosis of the brain. The subjects of sclerosis of the brain must be sought for in asylums, as in these patients there co-existed serious mental defect.

Description of New Perimeter.

By A. C. Hudson, F.R.C.S.





The instrument is constructed with two arms, having a radius respectively of 33 cm. and 100 cm., and united tangentially by means of a horizontal tubular axle to a vertically-disposed disc 1 metre in diameter. The single carrier for the targets of the two arms consists of a flat strip of flexible metal working on the posterior aspect of both arms behind a central slot and completely hidden from in front. From the extremities of the carrier two catgut cords pass to the axis of the instrument, through the central axle to the posterior surface of the disc, and thence upwards or downwards to become continuous with one another over pulleys above and below. Indicators on these vertical cords thus traverse the posterior surface of the disc in precise conformity with the movements of the carrier and the targets borne by it. Using a target on one or other arm as desired, the examiner is enabled, by recording with chalk on the back of the disc the various positions of the indicator on the corresponding vertical cord, to map out the whole field at a distance of one-third of a metre or the central third of the field at a distance of 1 metre. An outline of the normal field of each eye for the shorter radius is engraved on the back of the disc.

The PRESIDENT, having invited criticism (to which there was no response) said the only objection he knew of to the instrument was the one Mr. Hudson himself pointed out, namely, its expense. It was a very good and ingenious instrument.

The Clinical Significance of Deep Tension in the Eye in its bearing on Glaucoma, as Illustrated by Rubber Balloons.

By RAYNER D. BATTEN, M.D.

MY object is to advance two points. One is, a clinical symptom which, I consider, exists in the eye, namely, "deep tension" or "resistance." The other point is, that the passive expansion which occurs in rubber balloons without increase in pressure, occurs also in eyes with normal or sub-normal pressures. It is difficult to avoid mixing up the words "tension" and "pressure;" in the case of the eyes there is a tendency to employ them as alternative terms, but the two are distinct. Part of the experiment is to show that they are not alternative, but two different states.

For the experiment I use two india-rubber balloons of equal size freely communicating with each other and with a manometer. Rubber bellows are used for pumping air into them. The pressure in the two balloons is therefore always equal throughout the experiment. Air is forced into the balloons and the pressure raised. Up to a certain point the expansion of the balloons and their tension remain equal, but if more air is pumped in the elasticity of one of the balloons gives way and it expands while the other contracts slightly; at the same time the pressure in the manometer falls and continues to fall to a minimum point where it remains stationary. The pumping in of more air does not raise the pressure, so that with the fall of pressure in the manometer the tension in the smaller balloon becomes less, while in the larger the tension becomes greatly increased, and the difference in tension between the two balloons under equal pressure becomes very marked.

The explanation of difference of tension in the two balloons I consider to be two-fold, viz. (1) in superficial tension, (2) in deep tension.

(1) The larger balloon feels harder because the actual membrane is thin and stretched and its true tension increases.

(2) If deeper pressure is made in the balloon a sense of resistance is felt, due to the fact that the air cannot be pressed out of it without raising the pressure in the manometer. This resistance to deep pressure I propose to call deep tension.

The smaller balloon feels the softer of the two, because the actual walls are thicker and not stretched taut, so that its true tension is slightly less than in the larger balloon. But if deeper pressure is made on the balloon the whole of its contents can be pressed out without raising the pressure in the manometer, that is, there is no deep tension or resistance, and hence the main cause of difference of tension in the two balloons.

When feeling the tension of eyes, the lightest touch of which one is capable is applied. Deep tension in the eye is represented by the extent to which an eye will dimple to a given pressure. The amount of this dimpling varies in different eyes. In some the superficial tension is so soon passed that there is a danger of mixing it up with deep tension. When there is very little fluid to be pressed out of the eye it gives rise to a sensation of deep tension, which will increase, and may merge into glaucomatous tension. I regard it as a valuable premonitory sign of glaucoma. It does not, in itself, cause glaucoma, but, coupled with a fairly deep excavated disc, it is capable of merging into glaucoma.

After passing the critical point, expansion may take place without rise of pressure; the expansion goes on at a rate something below the normal pressure. That is what probably sometimes occurs in myopia. In those cases of large so-called physiological cups, which go on expanding with subnormal or normal pressure, this may explain progressive glaucomatous cups where no tension can be detected.

If deep tension and its significance were more widely recognized it should prove of clinical value, both as a sign of glaucoma and in other conditions. But it requires much more study than it has yet received.

DISCUSSION.

Mr. M. H. WHITING said he gathered that the white ball was made of thick rubber, the black one of thin rubber, consequently the former required a greater dilating force than the latter. In the experiment, the black ball became expanded as soon as the original resistance was overcome, and the pressure required to expand it still further became less as it expanded; the mercury in the manometer fell. But at a certain stage the limit of the elasticity of the black ball was reached. On dimpling the black ball one tried to overcome the rigidity which had been reached in it; it was no longer elastic, but rigid. The white ball still retained a considerable margin of elasticity, hence it expanded slightly and dimpled, and the tension appeared to be slight. He did not, however, see how it could be contended that these conditions were reproduced in the eye, because the elasticity of the eye was so small, at no one moment was it capable of much expansion, though after exposure to pressure for long periods it did expand with structural change.[1]

Mr. GRAY CLEGG thought that this was a problem which concerned the physicist; but if conclusions were to be drawn by ophthalmologists from Mr. Batten's findings, it would seem that the tonometer must go by the board.

Mr. BATTEN (in reply) said he thought the experiment had a definite relation to problems met with in the eye, although he was aware the eye tissues were not rubber. The membranes probably followed the same laws. He was not insisting that the experiment really proved anything, but showed in an exaggerated form conditions which he thought did occur in eyes.

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[1] *Postscript.*—I understood from Mr. Batten that the two bulbs were, as far as possible, similar. It must, then, be considered that some accidental circumstance, i.e., one not intentionally included in Mr. Batten's experiment, determined which bulb should expand first.—M. H. W.

Variations in the Size of the Physiological Cup and their Relation to Glaucoma.

By Ransom Pickard, C.B., C.M.G., M.S.

The variations in size of the physiological cup are of such importance in dealing with questions of glaucoma that finding little or nothing on the subject in the books to which I had access, I resolved to investigate it myself. At the Oxford Ophthalmological Congress of this year Mr. Hugh Thompson read a paper on the subject, but I have not as yet seen it.

METHOD.

The cases were a consecutive series, no selection being exercised except to eliminate all possible cases of glaucoma and other diseases affecting the disc, and except that in occasional short periods time did not allow of the drawing of the discs. It will be seen that there are objections to be raised to the group of cases employed, for they came because they had some affection of the eyes, and not because they were part of the average population.

It is, however, noteworthy that the total numbers dealt with in the later age groups correspond very closely with the population age groups in Devon, as shown by the following table, except in the 76-85 year group, which is hardly more than half its right proportion. Possibly the greater invalidism of this advanced age prevents them seeking advice.

TABLE I.—COMPARISON OF CASES WITH DEVON POPULATION.

Years	Hypermetropic	Myopic	Glaucoma	Totals	Devon population by ages	Eyes, per cent. of total	Population by ages, total
46-55	123	7	9	139	74,682	45·0	42·5
56-65	67	6	16	89	51.464	29·0	29·3
66-75	40	2	22	64	34.993	20·9	19·9
76-85	11	0	3	14	14,192	3·5	8·0
Totals	241	15	50	306	175.331	100	100

In the case of those aged under 40 glaucoma is so rare that the cases may be taken from this point of view as normal. After that age care has to be taken to eliminate possible cases of this condition. It may fairly be stated that the older the patient the greater the presumption that pathological changes have taken place in the eyes, among which glaucoma accounts for a large proportion. Thus, much care must be taken in the later age periods before a disc can be pronounced normal. Wherever necessary, the tonometer for pressure, and the screen for the field of vision were employed, both the outline of the field and the condition of the blind spot being examined.

The disc and cup were carefully drawn of their apparent size in the notes of each case. These were transferred by carbon paper to graph paper. No attempt was made to deal with these diagrams as they were collected, nor until the whole series to be dealt with was obtained, to eliminate any unconscious effect upon the drawings which a knowledge of the earlier results might have. Care was also taken not to form a habit of drawing the disc of one side, e.g., the right, first, lest this might result in drawing one larger than it should be. The area of each disc was then measured, the results were reduced to a percentage, 100 being taken as the area of the disc. In this paper figures used for cup areas must be understood as percentages of the disc area obtained in this way. By this means a method of comparison was arrived at (fig. 1).

The cases were grouped in ten-year periods, starting at 6 to 15 years, up to from 76 to 85 years of age.

Curves for each age-period were formed by a series of dots, each dot being the upper end of a line equal to the disc cup percentage, the cups being placed in order, the shortest on the reader's left. Each curve is enclosed in a parallelogram, the height of which represents the area of the disc, the base line giving the number of cases (fig. 2).

The following points appear:—

(*a*) The curves are fairly regular, except towards the higher end. That is, a practically continuous series is found in each age-period till the exceptionally large cups are encountered when, as might be expected from their small number, there are marked steps.

(*b*) The curves are not symmetrical about the median—i.e., the lower end in several curves is not convex to the base line, though all the higher ends are more or less concave to it. In other words, the large cups are not balanced by very small cups.

(*c*) There is a general tendency for the curves to be at a higher level with successive age-periods up to 65 years, which is shown by a consideration of the median and quartiles of each period.

TABLE II.—HYPERMETROPIC CASES, CUP AREAS.

Age-period in years	6-15	16-25	26-35	36-45	46-55	56-65	66-75	76-85	Glaucoma.all ages, hypermetropia and myopia
Smallest cup	6	3	6	7	5	5	8	7	18
First quartile ...	10	14	14	13	15	17	15	—	32
Median	13	18	19	18	20	24	22	23	45
Average	15	19	19	19	20	22	21	22	44
Mode	9	16	19	16	20	26	24	25	47
Second quartile ...	20	21	24	24	25	28	27	—	54
Largest cup	43	49	36	51	55	50	36	37	100
Number of discs examined	79	80	68	117	123	67	40	11	48

(*d*) The curve of the 66-75 year period calls for special consideration. Its quartiles and median are not greatly different from those of the 56-65 period; but beyond the second quartile, in ten cases there are no cups with an area of over 36, whereas in the 56-65 period there are six over that size in a group of sixteen cases. The number of cases is too small to make any certain deduction, but it does suggest that the extremely large discs tend to pass into the glaucoma group.

(*e*) The myopic cases have large cups, though there are only two groups (16-25 years, and 26-35 years) in which the largest myopic cup is not exceeded by a hypermetropic cup. The number of myopic cases is small, so no attempt has been made to divide them except into ten-year periods.

(*f*) A comparison with the cups of glaucoma cases observed in the same series of cases will at once show the generally higher level in the glaucoma cases, though the beginning of the glaucoma curve is as low as eighteen.

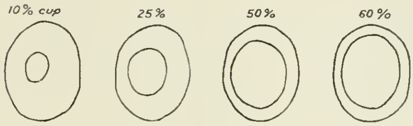

FIG. 1.—Size of cups compared with discs.

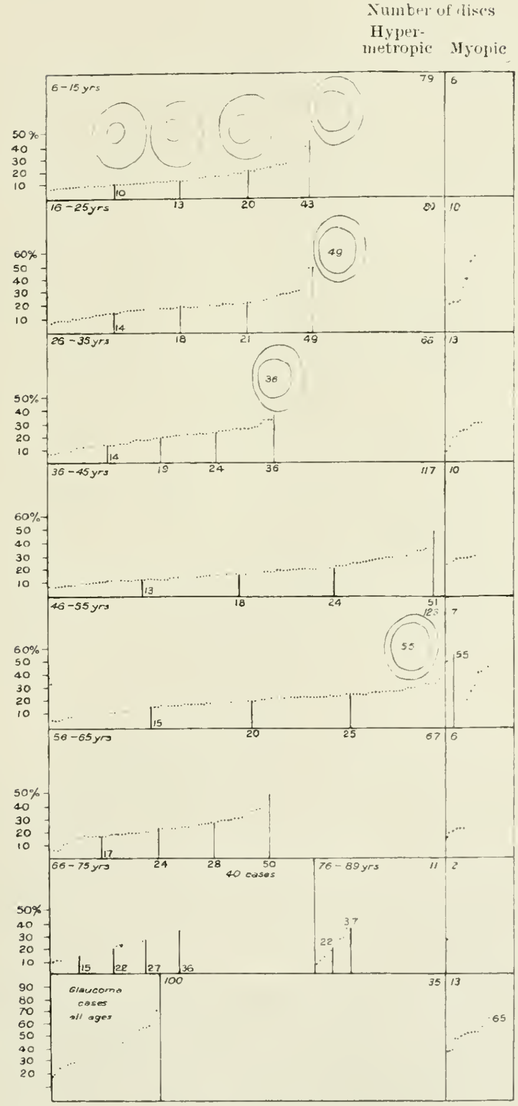

FIG. 2.—Curves of cup areas.

FREQUENCY POLYGONS.

The cases in each ten-year period are grouped according to the size of the cups—up to 10, 11-20, 21-30, as shown in the polygons constructed from these data. Myopic cases are placed at the top of each group and are indicated by shading, so that the influence of hypermetropia can be more easily singled out.

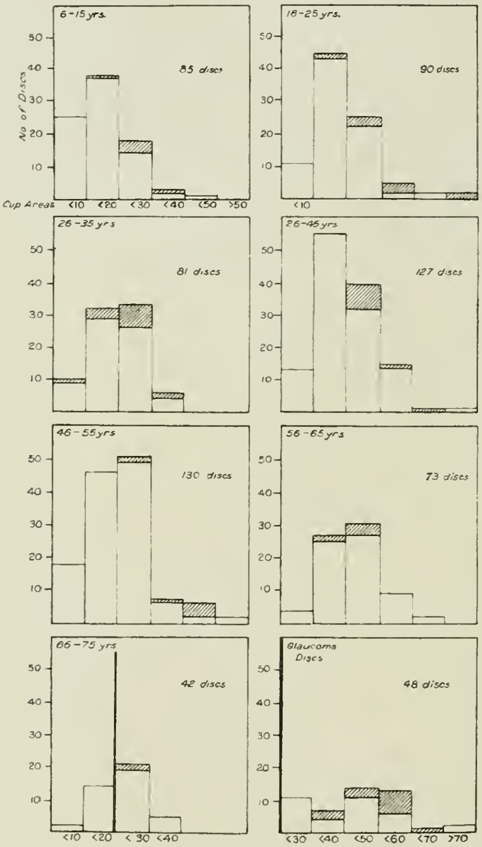

FIG. 3.—Frequency polygons (myopic groups shaded).

It will be seen that the exceptionally large cups are few. Attention should be given to the first three columns, comprising those in which the cups have an area up to 30 per cent.

In the first column, those with an area of ten or under, there is a marked decrease after the 6-15 year period, a fairly constant number till the forty-fifth year, then a decrease, very marked after the fifty-fifth year.

Of the second and third columns, areas of 11-20 and 21-30, it will be seen that the third grows and after the forty-fifth year overtops the second column.

In the remaining columns the numbers of cases are too small to allow any safe generalization to be drawn from them, but there is a tendency to have a smaller number of cases in the groups up to thirty-five years, and a larger number after that time. This will be seen more clearly if the following table is studied, in which they are reduced to percentages :—

Age-groups	Number of cups (hypermetropic and myopic)	Number of cups above 30 per cent. in area	Percentage
6-15 years	85	4	5·0
16-25 ,,	90	9	10·0
26-35 ,,	81	6	6·5
36-45 ,,	127	17	13·5
46-55 ,,	130	15	12·0
56-65 ,,	73	11	15·0
66-75 ,,	42	5	12·0

The polygons also demonstrate the tendency of the excessively large cups to disappear, the cases above 30 per cent. tending to become concentrated in the 31-40 per cent. block.

While this grouping in frequency polygons supports the general conclusions drawn from the curves, it shows more clearly than they do the decrease in number of the smallest cups and the increase in those of medium values in the successive age periods of this series of cases.

If one imagines that there is a tendency in many cases to an enlargement of the disc cup, the results would be just what has been found in this investigation, in a proportion there would be little or no tendency to enlargement, they would remain small during the whole lifetime ; others, initially varying in size, would gradually enlarge as life progressed, and pass in the higher series, causing the gradual alterations just described.

ASYMMETRY.

An investigation was made into the differences in size shown by the right and left cups in the same individual. A large number have differences, which may be summarized thus : the majority of differences are slight, the left being usually larger than the right ; a minority are considerable, and the larger cup is as likely to be on one side as on the other. Of 628 discs, twenty-one cups were larger than their fellows by over 10 per cent. of the disc area. The two largest differences observed were 21 per cent. and 28 per cent. respectively, both in patients under 25 years of age.

DIAMETERS OF CUPS.

Comparisons of the two principal axes of the cups with each other showed that considerable variations existed within each age-group, but that there were no appreciable differences between the different age-groups, the vertical axes being nearly always longer.

It is convenient to state here that in the glaucoma group there is a tendency for the axes to be more nearly equal in the largest cups, presumably an expression of the fact that with a given length of circumference a circle contains the largest area, an adaptation to the increased pressure within the eye.

The explanation of the alterations in normal disc cups involves many difficulties. An alteration in size of a cavity, situated in a solid like the sclerotic and filled by a viscous fluid such as the vitreous, might conceivably occur under three conditions :—

(1) No alteration in pressure, as in normal growth in which the increase in the solid wall and the fluid contents keep exact pace with each other.

Probably the increase up to the fifteenth year or a little later is an example of this.

(2) Tension from without, as in contraction or disappearance of nerve fibres or fibrous tissue. In the present series cases of this kind were ruled out, but a simple disappearance of fibrous tissue, such as Schnabel's cavernous atrophy, would cause the cases to be classed in the glaucoma group.

(3) Pressure from within — i.e., pressure exerted by the vitreous as in glaucoma.

The suggestion I have to offer is two-fold: that the tissues of all discs are not equally strong, and that small increases of pressure acting on the weaker discs over long periods of time may cause an enlargement of the cups in these cases, but not to the extent of interfering with vision. It is to be noted that, the cup presenting a larger surface to the vitreous pressure than a portion of the surface of the disc equal to the cross section of the cup at the disc surface, the vitreous tension would tend to enlarge the cup more than to depress the disc as a whole, so that slight yieldings would be shown by enlargement of the cup, not by depression of the disc surface.

COMPARISON OF THE SHAPES OF THE GLAUCOMATOUS AND PHYSIOLOGICAL CUPS.

It is convenient here to compare the shapes of the glaucomatous and physiological cups, for in the former we have a condition undoubtedly due to pressure from within.

No attempt was made to include in the investigation an accurate estimate of the depth of the cup, as this is a subject of much difficulty and introduces complications in the estimation of results, and is not so important as the fact whether the cup is enlarged in area or no.

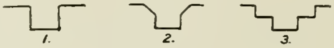

FIG. 4.

The shape of the physiological cup varies from the tiny dimple that one gets in the pseudoneuritis of some hypermetropias, to the well-marked cup with steep side with which we are all familiar. Some physiological cups have not vertical but decidedly sloping sides, so that their shape is conical, terminated below in cylindrical form.

In dealing with cases of glaucoma during this investigation care was taken to distinguish between various shapes shown with a view to deciding whether the condition of enlarged glaucomatous cups was an enlargement of the physiological cup, or superimposed upon it. Conceivably the various forms of the cup shown in section in the diagram (fig. 4) might arise: (1) Being a simple enlargement of the physiological cup; (2) being a conical enlargement of it, ending in a cylinder; and (3) the shallow cylinder involving an area of the disc decidedly larger than that of the physiological cup, and terminated abruptly in the latter, being superimposed upon it. In the cases of glaucoma which have come under my notice during this investigation it will be seen from the diagrams shown that a regular series might be constructed from those indistinguishable from rather large physiological cups to those typically glaucomatous and occupying nearly the whole of the disc. It was exceptional to find the conical form as indicated in (2), and in this group the third form was not observed, though it does occur (fig. 5).

If this series of glaucomas be typical, it would follow that the glaucoma cup is usually a simple and symmetrical enlargement of the physiological cup, that in a smaller proportion of cases the conical enlargement of the cup is added upon the usual cylindrical form, and that the third form is at least rare.

If it be admitted from these drawings that the glaucomatous cups are, in the majority of cases, enlargements of physiological cups caused by internal pressure, it is fair to argue that smaller degrees of pressure, acting upon cups of which the tissues are weak, will produce smaller degrees of enlargement without necessarily any deterioration of vision, because the pressure is not sufficiently great to cause injury to the nerve fibres. A clinical, though not a pathological, analogy may be found in the very varying degrees of increased arterial tension which come on frequently in middle life without symptoms arising from it.

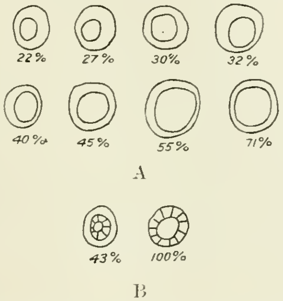

FIG. 5.—A, glaucoma cups arranged to show their growth from physiological cups. B, glaucoma cups, conical, ending in cylinder in the depth.

Very varying degrees of tension cause glaucoma and have very different effects upon the disc. In some cases a tension that is easily borne by most eyes will cause deep cupping and a field of vision typically glaucomatous, in other cases a tension beyond the normal produces little or no effect. That is, pressure is not the only factor, the resistance of the disc comes in, it is the correlation of these two factors which decides the effect on the size of the cup.

It will be seen that if my suggestion is correct that the cause of these enlarged cups is a matter of pressure from within ; it is, theoretically at least, including such cases under glaucoma, if this term be held to include all the results of pressure. But glaucoma should not be in my opinion so regarded, but should include only those cases in which there is pressure sufficient to interfere with the function of the organ. Thus an enlargement of the cup, if unaccompanied by any great rise of pressure and without any effect upon the central vision or the field of vision, should be regarded as a physician would regard cases of increased arterial pressure existing without symptoms referable to it, in other words, the enlargement of the cup is to be regarded as a danger signal, but not as glaucoma if unaccompanied by other signs of glaucoma. We should regard this group of enlarged disc cups as providing the material from which some groups of glaucomas develop. They should be cases in which accurate and thorough investigation should be carried out periodically, in which all predisposing causes should, as far as possible, be eliminated, but should not yet be regarded as glaucoma cases, for in many of them glaucoma may never develop.

It is acknowledged that the main conclusion of this paper, that there is a tendency for the physiological cup to enlarge as age progresses, cannot be regarded as proved but merely inferred. A few cases carefully followed through a series of years, with accurate comparisons of careful diagrams, would do much more to establish or refute this conclusion than deductions drawn in the manner followed in this paper.

ADDENDUM.

Since writing this paper I have been able to observe two cases of enlargement of disc cups. One was a girl, aged 8, seen in January, 1920, and again in January, 1921. At her first visit the percentage size of the disc cups were: Right 11, left 10; in January, 1921, the sizes were. right 28, left 26; an increase respectively of right 17, left 16. It is to be noticed that the increase is not symmetrical; in the right eye it is mostly down and in. in the left down, in, and out. Asymmetrical growth is quite in harmony with the suggestion that in young people growth and not pressure is the cause of the increase in the cups.

The remaining case is that of a woman, aged 68. seen first in July, 1920. and again in November, 1920. The disc cup percentages at her first visit were, right 23, left 24; at the second visit, right 23, left 50, an increase of 26 per cent. in the left; when there was in that eye slight increase in tension, slight general contraction of the field and notching above, diminution of vision from $\frac{6}{5}$ (3) to $\frac{6}{9}$ (5), but no enlargement of the blind spot. As a fine spicule of opacity has developed in the lens, much emphasis cannot be placed on the diminution of central vision; but the tension and outline of the field justify the diagnosis of this case as one of early recent glaucoma in which the enlargement of the cup has actually been observed.

DISCUSSION.

Mr. A. HUGH THOMPSON said that this paper tended to support the view that there was a distinct relation between a large physiological cup and a glaucomatous cup. Where there was undoubted glaucoma in one eye he had more than once noticed a large overlapping physiological cup in the other eye; and one knew that where ordinary glaucoma had occurred in one eye the chance of it occurring in the other eye was great. With regard to the mode in which physiological cups were changed into glaucomatous cups, he was interested in Mr. Pickard's suggestion that it was due to pressure from within on the lamina cribrosa. as the lamina cribrosa exerted unequal resistance to that pressure, thus causing an alteration in the shape of the physiological cup. That accorded with his own idea. and he believed Colonel Elliot had noted the same thing in his book. But he would join issue with Mr. Pickard when he said that the majority of glaucoma cases were caused in this way. The speaker's view was that these cases were decidedly exceptional. The ordinary glaucoma was the glaucoma of the text-books, in which the glaucoma cup began at the margin of the disc. And, in this connexion, he suggested that the author did not sufficiently distinguish between what he called the conical—the ordinary shallow cup which most discs showed—and the perpendicular cup, which, in his experience, was very often overlapping, so that vessels could be seen to come to the edge of the cup and then disappear, appearing again on the lamina cribrosa; they could not be traced along their whole course. His experience had taught him to regard as the dangerous cases those with a large overlapping physiological cup, not the conical cup cases.

Mr. RAYNER BATTEN said that what was required was some method of recording the cases of central cupping; the recording of the area alone did not meet the want. The so-called physiological cups which he regarded as dangerous were those of a particular shape and distribution; the actual central cup he looked upon as comparatively innocent; it became dangerous when it got up to the margin. While it remained in the centre it could almost be considered as Nature's trephine hole. Nearly all the cups in Mr. Pickard's cases appeared to have been central. The cups with which the speaker was familiar came quietly up to the temporal side and expanded from there; they rarely occurred on the nasal side. One reason for his bringing forward the rubber balloon experiment was to show that passive expansion could take place without increased pressure to account for the growth of a physiological cup. He agreed with Mr. Pickard that there were preliminary or premonitary signs of glaucoma, and those should be known. When there was a large physiological cup and deep tension was elicited then the margin between that and actual glaucoma was very small. It was not as yet actual glaucoma, there might be no tension ; but when deep tension was increased and the cup was large glaucoma might easily supervene.

Mr. M. S. MAYOU said the histology of the two forms of cupping was entirely different and could have no relation to each other. The physiological cup was merely the cone of nerve fibres passing into the nerve, whereas the glaucomatous cup was formed by the pushing back of the whole lamina cribrosa. In the latter one would always expect a steep-sided cup, and in advanced cases in sections of the disc one could see the cup bulging out under the sclera on either side. True cupping in contradistinction to physiological cupping was not only dependent on the intra-ocular tension, but also on the support given by the nerve fibres as they passed through the lamina cribrosa. In anencephaly, in which there were no nerve fibres, one found a large cup with no intra-ocular tension, because it was unsupported. If optic atrophy occurred in infants the lamina cribrosa would yield with normal pressure and cupping would result. He thought that, clinically, one could not say for certain judging by the appearance of the disc alone that a given case was one of glaucoma without the confirmatory evidence of the fields of vision, &c., but if the cup went up to the margin of the disc there was more than a strong probability of its being of that nature.

Mr. N. BISHOP HARMAN asked whether it was not necessary to take into account possible variations in the size of the optic disc. If it were assumed that the optic nerve fibres were more or less constant in bulk, and if the optic nerve opening in the sclera were larger in one eye than in another, there must be a space in this opening which was not filled up by the nerve fibres. This he thought, was the cause of the physiological cup, and he conceived that the cup varied with the size of the opening in the sclera. It was difficult to make up one's mind as to whether two discs were of the same size ; he had many times tried to take measurements, but had never convinced himself he had obtained a proper representation as to this, owing to the difficulty presented by differences of refraction. Certainly there was a difference in the kind of case of which Mr. Mayou spoke. And if, in a gross pathological condition, there was such a feature, it was probably present, in less degree, in normal eyes. Had Mr. Pickard endeavoured to measure the discs in the eyes he had examined and could he give information on the point ? If it were held that the physiological cup was definitely related to the size of the scleral opening, then its significance was anatomical rather than pathological.

Mr. PICKARD (in reply) said that evidently the opinions of those who had discussed the paper were against his contention that the majority of cases, in the early stages, arose out of the physiological cup. In this series he had worked minutely at the matter with the object of finding borderline cases ; it seemed that it was in that direction one had to work to find out the real cause of glaucoma. He had set forth a graduated series of cases arising from the physiological cup, and they were carefully explored. He admitted that some of the cases were only slight. As to whether the glaucoma cup usually started at the margin, whether it was a depression of the whole disc, or whether it began in the physiological cup, with or without a cone, he could only say he had drawn the discs with extreme care, much to his own instruction, and he had been struck by the large number which arose as, apparently, simple enlargements of the physiological cup, not as depressions of the whole disc. In this paper he had considered the shape of the disc, he had not gone into the mechanism of causation. Ophthalmologists became biased towards the belief in the depression of the whole disc because of the number of advanced cases which came before them. It was in the early, slight, cases one could see the condition of glaucoma originating as an enlargement of the ordinary physiological cup. He did not contend that this accounted for the majority of cases of glaucoma, but for a certain group. The enlargement was usually towards the temporal side, but this was not constant. The question raised by Mr. Bishop Harman was a very interesting but difficult one, namely, as to the variations in the size of the disc. There was certainly much variation. Members knew the huge discs sometimes met with in myopia: that apparent size was a matter of refraction, but he had seen fairly high myopia with apparently small discs. The shape of the disc was usually drawn as a very nice oval, or approaching a regular circle. But that was unusual. There was much variation in shape. The absolute size was a mathematical problem, and he did not feel capable of dealing with it adequately from that side. That was why in delineating the cups he had recourse to percentages, rather than to absolute dimensions.

Section of Ophthalmology.

President—Dr. James Taylor, C.B.E.

Commotio Retinæ with Extreme Œdema.[1]

By F. Arnold Williamson, F.R.C.S.

C. R., male, aged 15, van guard; duration of disease, five days.

History of case: Received a blow in right eye from a hanging piece of rope six days ago while in some swings, and vision in right eye was immediately lost. First seen by me four days ago, since when œdema has slightly subsided.

Points of special interest: Disc outline obscured, vessels partially hidden by folds of œdematous retina. Highest point of disc $+3\cdot5$ D., general retina $+1\cdot5$ D. Macula reddish brown colour, perimacular region occupied by white area, similar to that seen in embolism of the central artery. Two horizontal folds are present, one running through the macula, the other a little below. A short distance down and in from macula are a few small hæmorrhages. The condition of the fundus would suggest a rupture of an artery.

DISCUSSION.

Mr. J. B. Lawford said the case was interesting because so unusual. He had never seen such an appearance directly resulting from injury, in fact he had been wondering whether the occurrence of the injury was a mere coincidence. But the history had such definite association with the blow: the eye being discovered to be sightless, or nearly so, immediately after the injury, that this was difficult to maintain. He did not think a vessel of any considerable size had been ruptured, otherwise hæmorrhage would have been visible. The amount of change in the retina, especially the folding, was remarkable.

Mr. Leslie Paton said he first saw this case with Mr. Williamson three days before, and was at once struck with its resemblance to an embolism of the central retinal artery. The white area was then even more extensive, and the spot on the macula was of cherry-red colour. He was anxious for members to see it, because it seemed to suggest there might be some block of a vessel as a result of the concussion. He had never seen so much œdema result from simple commotio retinæ. In a case shown some years ago of rupture of the optic nerve, there was retinal œdema, even more extensive than in this case. He thought it possible there might have been a tearing through the nerve in this case, which had affected some vessel, but the hæmorrhage from it had not come to the front. He asked whether those who had been observing war cases had seen such an injury to the eye followed by extreme œdema, i.e., without a vascular complication such as rupture of an artery or an embolism.

Dr. George Mackay (Edinburgh) said he had rarely, if ever, seen such an intense retinal œdema following injury. He had recently under his care a case of concussion of the retina in a young lady whose eye had been struck by the brass knob of a fire-screen. The retinal œdema, however, in that case was only slight, though sufficient to produce an approximately quadrantic partial scotoma upwards. The macula was not involved and direct vision remained unimpaired. A month later the œdema and the scotoma had cleared up, only a fairly large capillary hæmorrhage—previously screened by the œdema and situated close to a vena vorticosa—remained to indicate the seat of the injury. Mr. Paton's suggestion seemed very reasonable that, in the case exhibited, the textures had been torn behind the plane made visible by the ophthalmoscope, causing rupture and thrombosis of the vessels and blocking of the lymphatics.

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[1] At a meeting of the Section, held February 11, 1921.

Artificial Eye and Lids attached to a Spectacle Frame.

By M. W. B. Oliver and T. Jackson.

GUNSHOT wound of right eye January 1, 1915. Considerable damage to lids, and the right eye was excised. Three operations were performed in order to make a socket which would hold an artificial eye, but none of these were successful, the socket was therefore excised and the lids closed, and artificial eye and lids attached to a spectacle frame.

DISCUSSION.

The PRESIDENT said the method was of extraordinary interest from the æsthetic standpoint, because looking at the man from a fair distance one did not detect that there was anything the matter with him. The exhibitors had shown ingenuity, the issue of the plastic operations had been most successful, and the manner in which they had surmounted the inevitable scarring associated with these operations was striking.

Mr. J. B. LAWFORD, expressing the interest attaching to this exhibit, said that such cases did not often come under notice in civil life, but about twenty years ago he had a patient under his care at St. Thomas's Hospital, a girl aged about 20, one of whose orbits he had to exenterate. She was, naturally, anxious to have her appearance improved, and he had a similar apparatus to that now shown made for her at Birmingham, and she wore it during the remainder of her life. It was a case of tumour, which became disseminated. She died about two years after the first operation. The apparatus was extremely well made, and the colouring was very natural.

Mr. JACKSON (who was responsible for the workmanship) said it was a very complicated procedure. A plaster cast was first taken of the patient's face, and the deformed side was built up in plasticine to correspond with the normal side. An overcast of the part to be restored was taken in plaster, and a wax constructed of the part. This wax was next imbedded in investing material, and by some casting apparatus the part cast in silver. This formed the mask. This part was tried in position on the patient and the relative position of the glasses obtained. The artificial eye was held in position by a soldered metal cup and the glasses fixed to the mask. There remained only the painting to complete the work. It was of considerable advantage to have the mask as small as possible: if the mask involved a large portion of the cheek any movements raised the prosthesis and showed the edges.

Rare Condition of Optic Disc, (?) Coloboma.

By Reginald Thorpe.

PATIENT, a boy aged 5. I have sent the case up in the hope of eliciting opinions of members of the Section concerning its precise nature. There is no history which can throw any light on the condition. I suggest that a pre-natal inflammation has interfered with the development of the disc. The labour was normal, chloroform was not administered, nor any instruments used in the delivery of the child at birth.

DISCUSSION.

Mr. LESLIE PATON suggested that the case should be watched, and brought again in a year or two, to see whether by that time it had come to resemble the case shown by Major Carruthers two or three years ago, or the other which he (the speaker) showed eighteen months ago. In both of these the condition was more defined on inspection. There was still some doubt as to the nature of these cases. In his own case nothing had occurred since to throw any light on causation.

Mr. J. H. FISHER said it did not appear to him like a developmental condition. He had no knowledge as to the kind of confinement the mother had, but the condition might be due to a birth injury. Pigmentary changes seemed to extend far into the retina; such changes were unlike any developmental abnormality, but might be explained on the hypothesis of a causation of posterior ciliary vessels around the porus opticus.

Illuminated Needle-holder with Corneal Loop attached.

By BASIL T. LANG, F.R.C.S.

THIS is designed for use when one has no assistant. The corneal loop is focused on to the end of the needle, spud or gouge, and the light directed to the same spot. One thus obtains good illumination and definition of the foreign body and its surroundings, which make its removal an easy matter. If the needle, spud or gouge be removed, the instrument can conveniently be used for examining the cornea. When I showed it to Mr. Holmes Spicer, he suggested that the instrument might also be used as a transilluminator, and Mr. Baxter (of Messrs. Weiss) has succeeded in accomplishing this.

A New Form of Scotometer.

By BASIL T. LANG, F.R.C.S.

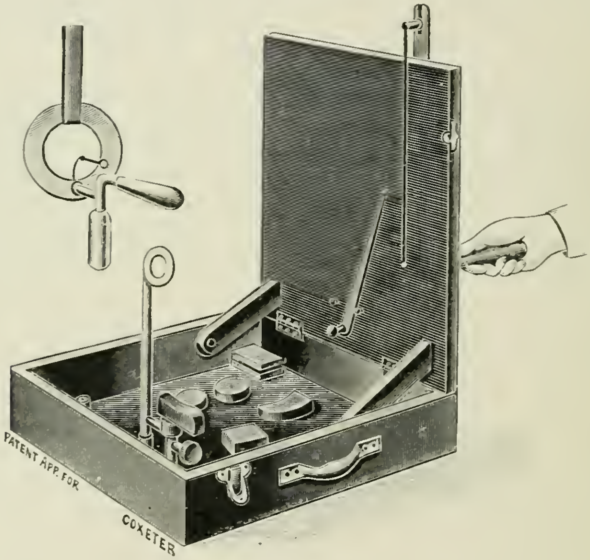
THIS scotometer differs from others in that it enables the surgeon to watch the patient while he is plotting out the scotoma and also allows of the examination of the scotoma so plotted out without disturbance of the chart or screen or background.

The whole apparatus packed into a portable box 36 cm. by 30 cm. by 8 cm., the lid of which lifts up to form the background, the chin rest being mounted on the opposite side. The chart is fixed on the back of the lid, out of sight of the patient. The object holder consists in a handle mounted on a flat metal ring through which a pricker, attached to a spring, operates. The arrangement is shown in the figure (p. 44). On this ring is mounted a wooden arm some 30 cm. long. At the end of this arm the object holder proper is hinged, and so arranged that the object is lying just in front of and about 2 cm. distant from the point of the pricker.

In use, the object holder is passed over the edge of the lid, and the flat ring pressed against the surface of the paper, on which it slips smoothly. Pressure with the thumb of the hand holding the handle on the pricker will thus mark the chart on the back of the board at a point exactly corresponding to the position of the object.

The patient looks at the target. The object is moved until the edge of the scotoma is determined, when its position is marked. It will be noticed that the target may be moved to the right or to the left. Most investigations are carried out in the neighbourhood of the blind spot. If therefore the left eye is being investigated the chin rest and the target are both moved to the right hand side as in the diagram. The blind spot thus falls at or near the centre of the board. Any piece of thin paper is used as a chart. Ordinary typewriting paper is quite suitable. It is pinned on to the back of the board, and before the scotoma is plotted out the position of the central fixation point —i.e., the target—is marked by moving the handle until the object is lying over the target and then marking the chart. It is convenient to put a pencil ring around this mark.

When the examination of the scotoma is complete, the object is removed, and the scotoma inspected before the chart is removed. It not infrequently happens that the surgeon has left so large a gap between two observations that he is not justified in assuming that a straight line joining them represents the limits of the scotoma. He therefore has to determine the margin of the scotoma at some intermediate point. He replaces the object holder, finds the desired area by examining the chart through the hole in the flat ring, and moves the object until the pricker is midway between the two previously observed points. He now transfers his attention to the patient, and moving the object in the appropriate direction determines the position of the margin accurately.



A piece of card is provided with the scotometer on which concentric circles are drawn, 5 of arc apart. The chart is laid on this card with the ringed mark representing the central fixation point over the centre of the circles, and the circles near the scotoma pencilled in. In doing this, the surface of the paper that was nearest the patient must be uppermost, as of course all fields are drawn as seen by the patient and as never viewed by the surgeon.

Scotometry.

By Basil T. Lang, F.R.C.S.

When I was asked to read a paper on "Scotometry," I began to ask myself what were the limits of the subject, and how it differed from perimetry. In scotometry one is concerned with scotomata, that is, more or less blind areas surrounded by more or less healthy, seeing, retina. The term is applied, I believe, by common consent, to the investigations of those areas near the fixation point, within 30° to 40° of it.

It differs from perimetry in no respect other than that it involves a more detailed investigation.

Two types of scotoma are recognized—absolute, when an area of the retina is quite inappreciative of all light, and relative, when, although it can appreciate brightly illuminated white objects, it is inappreciative of certain colours or grey, or even, on occasion, of white objects if the illumination be sufficiently reduced.

In determining the size of a scotoma, various points have to be considered. These are:—

(1) Illumination.
(2) Colour of the object.
(3) Colour of the background.
(4) Size of the object.
(5) Rate of movement of the object.
(6) Distance of the object.
(7) Scale and size of the chart.
(8) Method of making the observations.
(9) Influence of the patient's refractive error.

(1) *The Intensity and Colour of the Illumination are important.*—One desires to find out if any part of the retina is even only partially insensitive to light. If quite a small object be very brilliantly illuminated it may be quite possible for it to be seen over an area in which a much larger, but poorly illuminated, object may be invisible. The light should not therefore be too intense. Direct bright sunlight should be avoided. Indirect sunlight and daylight vary in intensity from day to day, and in colour from season to season. Thus a scotoma might be found to vary from time to time with varying intensity and colour of light when, in reality, it is of unaltering size if examined under strictly comparable conditions. No standard of artificial illumination has yet been agreed upon, but the light from a single carbon filament lamp, such as is used in ophthalmoscopic examinations, half a metre from the object is found to be fairly satisfactory as long as the lamp is new. The great disadvantage of all forms of carbon filament lamp, however, is that they alter rapidly both in colour and intensity after only a few hundred hours of burning. Recently two lamps standardized as to colour have appeared on the market. I refer to the Sheringham Daylight Lamp and the Chance Daylight Glass. They both employ gas-filled (so-called "half-watt") lamps, and by correcting this light each produces what is substantially daylight. The difficulty in employing either will be in keeping the light intensity sufficiently low. One probably does not require more than 20 to 30 candle-power, and it may possibly be necessary, until smaller gas-filled lamps are made, to place the lamps at some considerable distance from the object or to employ small white surfaces to reflect only a portion of the light.

(2) *The Colour of the Object is Important.*—Green is less easily seen than red, and red than blue, and blue than white. Green may appear to change colour into yellow or grey, and thereby demonstrate, even when using a comparatively large object, a change in retinal sensitiveness which, had white been employed, could only be discovered by using quite a small object and then only if in a dull light, and possibly not even then. When using a red object, the intelligent patient may observe that the intensity of the colour itself may vary in different parts of the field, even though the object itself does not become invisible.

(3) *Background.*—There should be a marked contrast between the colour of the object and the background. This may conveniently be black or grey. It should not reflect any light. Some surgeons use a white background and a black object. This method works admirably for plotting out the blind spot, but difficulties arise as soon as attempts are made to determine the size of a relative scotoma. A green object, invisible on a black background, becomes a black object on the white background. Further, the handle on which the object is mounted, unless exquisitely white, is very obvious against the background and may throw a shadow. Complications arise in dealing with a relative scotoma, in that the retina may become partially fatigued and the result obtained may not be comparable with that found when a black background is used.

(4) The *size of the object* should be measured in terms of the angle that it subtends and not by the length of its edge, otherwise a comparison of the results obtained by different observers working at different distances is difficult. Some observers state that half a degree should be the smallest size used. If one only uses this large size and does not also go over the field with a coloured object, one will almost certainly fail to find a small scotoma. The object in an Elliot scotometer subtends about an eighth of a degree and is certainly not too small.

(5) *Rate of Movement of the Object.*—This is a matter of utmost importance—of a great deal more importance than is usually accorded to it. If the surgeon is anxious to discover areas that are possibly only slightly less sensitive to light, the patient must be given time to consider and make up his mind as to whether the object does change in appearance or colour. If, when employing similarly coloured objects subtending the same angle, different results are obtained when working at different distances, as for example with a Bjerrum screen at two metres and a perimeter at 33 cm., the principal, if not the only, reason for the discrepancy is the difference in the speed with which the object is moved in the two cases. It will be noticed that most surgeons move the object when working with a Bjerrum screen, at two metres, not more than 4 to 8 cm. a second, that is 1° to 2° a second. In order to obtain comparable results when working with a perimeter, it is essential that the image of the object should pass across the retina at substantially the same speed. This means that the object should be moved at not more than one-sixth of the speed; that is, about 1 cm. per second along the perimeter arm. In order to attain this, the handle of the ordinary McHardy perimeter requires to be turned at about the same rate as the second hand of a watch. It will be admitted that it is rare for this precaution to be taken, and that usually when attempts are made to plot out a scotoma with a perimeter, the process is a less leisurely one than when a Bjerrum screen is employed. No standards of speed have been established. But they should be. The statement that no scotoma is present should always be qualified by giving the size and

colour of the object employed and the approximate speed at which it was moved.

(6) The *distance* at which the observations are best made is a most controversial topic. Some aver that the nearer the object is to the patient's eye the better. Others consider that it is only by working at two metres or more that really accurate observations are made. Subject to the conditions under which the observations are made being comparable, it is quite unimportant at what distance the object is from the patient, always excepting that it should not be too near. It is probable that if it be nearer than 33 cm. it is disadvantageous. The object is of necessity small and it is obvious that the patient should have a clear sharp image of it on his retina. He should therefore wear glasses to correct any refractive error he may have, with a suitable addition if he be presbyopic. Many of these patients are presbyopic and their reading glasses will not enable them to read at a distance nearer than 33 cm. It is difficult to get a patient to keep a trial frame and lens in place while taking out a scotoma, and therefore difficult to correct for an object nearer than his reading distance. For these reasons it is undesirable to work nearer than 33 cm. Not infrequently it will happen that one requires to take out the scotoma of a patient with a central scotoma. Then he will be instructed to place the tip of his index finger on the fixation spot and to look where the tip of his finger is (not to look at the tip of his finger, or he will look at it eccentrically and the result obtained will be valueless). Under these circumstances the central fixation point must be within reach and therefore should not be more than half a metre away at the most. All the earliest work was done at two metres or so. I believe that the original findings were only possible when working at such a distance because observations were made in daylight with white objects and that it was only by working at this great range and with minute objects that the intensity of the stimulus was sufficiently reduced to enable the small changes of sensitiveness of the retina to be discovered. With suitable appliances and appropriate conditions, quite as accurate observations may be made at the usual perimeter distance of a third of a metre.

(7) The *scale and the size of the scotometer chart* are purely matters of convenience. It is desirable that one degree of arc should be represented by at least as much as 2, probably 3 millimetres. If a smaller scale than this be used variations in the size of the blind spot, for example, may not easily be noticed. The chart should be big enough to include the fixation point and a part of the 30° circle.

(8) *Methods.*—There are many methods. A good method should (i) be easy to employ; (ii) give accurate results; (iii) enable a permanent record to be made easily; (iv) and above all, enable the observer to watch the patient, if necessary, the whole time to see if he is keeping his eye fixed on the target.

Most patients will allow their eye to wander unless they are carefully watched. When using Bjerrum's screen, one works two metres or so from the patient. One must watch where one is moving the object. One cannot therefore pay that attention to the patient that is usually necessary. Pins may be put into the screen to mark out the limits of the scotoma, and the position of these may be plotted out on to a suitable chart afterwards. The method is extremely accurate, but far from rapid. It requires the services of two persons, one to move the object and one to watch the patient. It is not self recording.

A considerable improvement has recently been introduced, and consists in attaching the object to one limb of a pantograph. This is used to reduce the size of the scotoma suitably, and by means of a pricker a permanent record is made on a chart that is mounted near the edge of the screen. The observer can now face the patient and watch his movements, but from a distance of two metres it is difficult to be sure that he is keeping his eye fixed on the target.

Elliot's scotometer is designed to be used at the distance of one metre. With it eventual plotting out of the scotoma is more rapid than in the case of a Bjerrum screen in that a numerical value is obtained for the position of the margins of the scotoma. It is more easily used if one has an assistant to copy down the numbers so found. By standing at one side one may obtain a tolerably good view of the patient's eye to see if he is keeping his attention fixed.

Accurate results may be obtained by using an ordinary perimeter. There are two objections to this method. The first is that the small object is usually mounted on a large object holder. It is difficult then to determine whether the patient sees the object or the holder. If a suitable object holder be employed the only objection to taking the field on the perimeter is the fact that the reduction is too great. In the McHardy of the usual type the 180° is represented on the chart by 100 mm., which means that the whole of the scotometer chart, that is up to the 30° circle, would only be the size of a penny, which is obviously far too small.

A perimeter fitted with a two-scale reduction device would be excellent but the charts must be made of such form that it would be impossible to use the wrong one. Some of the original recording perimeters had such a two-scale reduction device but they went out of use because the difference between the two scales was insufficiently great to avoid the possibility of mistakes, and one was at times in doubt as to whether the low or high gear had been employed more particularly, since for the sake of simplicity, they only employed one chart for both purposes. If the difference in the scales be great, say as much as six to one, this confusion could not occur. With such a perimeter when the scotometer gear was being used the driving mechanism would also be altered so that the speed of the object would appropriately slow.

When using a perimeter it is easy to watch the patient.

More recently other forms of instrument have come into use. They are simpler and therefore less expensive than a perimeter. During the war, Dr. Gordon Holmes used a screen of the Bjerrum type but worked nearer the patient. He employed an object holder which had a pin protruding backwards. With this a prick is made through the cloth on to a piece of paper placed immediately underneath. By this means one has a full sized record. Mr. Bishop Harman employs a grey screen at a third of a metre. Under this he has a piece of carbon paper and a chart. He uses a rigid object holder with a style-like process passing backwards. He marks the limits of the scotoma by pressing the holder backwards thereby obtaining a permanent carbon record.

In neither of these methods can one see the exact limits of the scotoma until one lifts off the screen. It not infrequently happens that when one is working out the limits of a crescentic or irregular scotoma, one wants to know if one has left any part of the margin incompletely defined.

For this reason the perimeter type of scotometer would be particularly useful. For this reason I designed a new form of scotometer. It has no advantage over a good perimeter, except that it is cheaper. One can watch the patient, one can observe where one has determined the limits and where one has not, and any piece of paper is suitable for making the record on. It is not necessary to employ a particular form of chart.

(9) When one is considering the size of the blind spot and comparing it with the normal, it is essential to remember that the refractive error will have a profound influence. In high myopia, for instance, the angle between the limits of the blind spot and the centre of the pupil will be a much smaller one than in the case of a high hypermetrope. In fact the disc of the latter throws a scotoma about twice the diameter of the former. This will account, I think, for the remarks of one observer at the Oxford Congress last year, who found that the size of the disc plus the myopic crescent was not much, if any, larger than the normal scotoma for the emmetropic disc.

Some extremely important observations may be made with a scotometer. It occasionally happens that a patient with a high degree of hypermetropia may possibly be the subject of increased intracranial pressure. The question then arises, is the swelling of the disc physiological or pathological? If the size of the disc when determined with a dull green is only slightly larger than with a brilliant white, the condition is probably physiological. If the scotoma for green be considerably larger, then the nutrition of the retina around the disc is disturbed, and the condition is probably pathological. The scotoma for colour is usually slightly larger than that for white.

In obscure nervous diseases with slight disturbance of visual acuity but no change visible in the retina, and no central scotoma, the blind spot may be enlarged for red or green.

In certain cases of toxic amblyopia and in cases of retrobulbar neuritis, scotomata for red and green or for green only may be found. At times the green is seen the whole time but is stated to change colour, turning to yellow.

Occasionally a paracentral scotoma may be found. Rarely, in cases of pituitary tumour, a small central scotoma strictly limited by the mid line, usually bi-temporal, may be present.

But of course the purpose for which scotometry is of such importance is the determining of the increase of the blind spot in cases of suspected glaucoma.

DISCUSSION.

Mr. N. BISHOP HARMAN, remarking on the view expressed by Mr. Lang that it was desirable for the observer to see the process of building up the scotoma, differed from that view, for when one knew the kind of result which was emerging, there was a definite tendency, he had found, for this knowledge to exert an influence on the actual mapping out of the scotoma. Certainly when one was unaware how the scotoma was coming out until the observation was complete, the satisfaction of the attainment of an unbiased result was the greater. The personal equation should be eliminated as far as possible. When he was doing some work with the McHardy perimeter, he put a hood over the working arrangements so that he should not be unconsciously biased. Mr. Lang had said that in using the Direct Record Scotometer which he (the speaker) had recently shown to the Society,[1] the patient's eye could not be watched. But he (Mr. Harman) had demonstrated to them that this advantage was the strong feature of the instrument. The provision of "landmarks" at the back of the screen which could be held in one hand (the central stem and the two knobs which gave the position of the blind spots) secured such a consciousness of the position of the objective and recording style which the other hand held, that there was no need for the observer to look at the screen; but he could after a very little practice watch his patient with ease and simultaneously register every movement of the style. The remarks made by Mr. Lang on the subject of scotometry generally were very true. The more one had experience of this work, the more was it necessary to allow for the peculiarities of the patient. He was also convinced as to the altered effects according to the light used. He showed his own scotometer at another clinical meeting in London, where the light was so bad that the blind spots tested came out 25 to 50 per cent. more than the average. It was said that the fields of patients suffering from tobacco amblyopia were full in the periphery, but if the illumination were reduced sufficiently, it was found not to be so; there was a real reduction in the periphery, just as in the centre;[1] he drew attention to this finding some years ago.

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[1] *Proceedings*, 1920, xiv, pp. 12, 13.

Dr. ARTHUR H. H. SINCLAIR (Edinburgh) said that in recent times many instruments had been devised for examining the more central zones of the field of vision, and it was astonishing to him that so little attention was given to the original work by Bjerrum on this subject, and the principle which underlay it. Much of the work which had been the sources of new knowledge on this subject—in some cases a great deal—was done by the originator Bjerrum, by Meisling, a small amount by himself (the speaker), by Ronne, of Copenhagen, who had done so much, by Walker, of Boston, U.S.A., and by Traquair, of Edinburgh. All those investigators realized the value of making the observations at a distance of 2 metres or more, and also the value of using a very small test object. The work which had been forthcoming from one or other of the authors mentioned depended, almost entirely, on the use of a large black screen as a background at a sufficient distance to enlarge the scotoma so that its details could be rendered obvious. The kind of scotoma which it was of importance to examine in early diagnosis was the relative scotoma. The scotoma might also vary in intensity within its limits in different parts. In toxic amblyopia, for instance due to tobacco, he had found not only an oval area which extended from near the fixation point, or round it to the blind spot, but within that area, smaller areas of deeper intensity were demonstrable in a proportion of cases, i.e., if testing were made at a sufficient distance and with a small enough test-object. He could show charts of such cases. While he appreciated the care with which various instruments had been developed, and their ingenuity, he thought it would be a matter of importance and great interest if some of the younger ophthalmologists could be induced to take up this subject with a view to the further elucidation of the problem of early diagnosis from the subjective point of view. He himself read a paper on the subject before the Ophthalmological Society in 1905, but he had not been able subsequently to devote the time to it he would have liked. Dr. Traquair had carried out valuable research work in Edinburgh. When in the United States he (the speaker) had seen Dr. Walker's instruments in Boston, but Dr. Walker himself was away. Dr. Walker used a large screen with a circle of electric lamps placed behind the patient, which illuminated the dark screen, and enabled the observations to be made.

Mr. ERNEST CLARKE said the important feature of the instrument now shown consisted in the observer being able to watch the patient. The Elliot screen was perfect, except for the point that one must have assistance to watch the patient. He suggested that Mr. Lang's ingenuity might enable him to make his instrument workable on a 2-metre scale. In reference to Mr. Harman's remarks, he (the speaker) understood that the observer could, if he wished, see what he was doing, but there was no real necessity for this.

Mr. B. T. LANG (in reply) said he did not think that he was influenced by the way in which the mapping of a scotoma was developing. He remembered taking out fields in which he could not have accurately defined the limits of the scotoma had he not been able to check what he was doing. It had been stated that it was quite easy to watch the patient while using Mr. Bishop Harman's instrument. This was not his (Mr. Lang's) experience. It was partly for this reason and partly because of the inability to observe the results during the progress of the mapping out of a scotoma that he had proceeded with the development of the scotometer that he was now showing. He agreed that the effect of light was very important; he much wished that someone in authority, illuminating engineers or other people, would say what candle-power should be used and what part or parts and proportions of the spectrum should be employed.

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[1] "The Visual Fields in Tobacco Amblyopia." *Lancet*, 1904, ii, p. 821.

The scotoma for red or for green would vary according to the illuminant—the yellow light of the carbon filament lamp or the blue-white light of the gas-filled globe. He considered that it was a matter that required investigating and standardizing. In answer to Dr. Sinclair, he did not think it made any difference so long as one was within the focusing range of the eyes how far the object was away from the patient. It was purely a question of the angle subtended by the object and the angular velocity of that object. The question of angular velocity had possibly not been quite sufficiently considered by many of the observers who worked at short ranges. The work of Bjerrum was doubtless carried out at 2 metres or more, because, in those days, the importance of illumination had not been appreciated, and it was only by working with minute objects at this great distance that a sufficiently small stimulus could be obtained to enable the scotoma to be mapped out in daylight. If the work had been carried out with artificial illuminants with coloured objects at a shorter distance the scotomata would have been discovered. It was important that the object be moved sufficiently slowly to enable the mental process of recognition to be performed.

On Late Infection after Sclerostomy.

By T. Harrison Butler, M.D.

THE first decade of the present century witnessed a definite advance in the campaign against chronic glaucoma which was initiated by von Graefe, who in 1857 published his paper upon the effect of iridectomy in glaucoma. This operation is still performed by some ophthalmologists for all varieties and by most for the acute form of the disease. Towards the end of the past century, however, there was a general feeling that the classical iridectomy for chronic glaucoma left much to be desired and that in the majority of cases it failed to normalize the intra-ocular tension. The most favourable statistics showed that at most 50 per cent. of iridectomies were successful in chronic glaucoma, and many surgeons would not admit more than 40 per cent. My own iridectomies have been satisfactory in not more than 45 per cent., and many, if not the majority, of the eyes that have been saved show a fistulized scar. Recognizing the need for improvement, de Wecker attempted to devise an operation which would give a filtering scar, and his sclerotomy was widely practised with, however, no notable success. Even to-day it had adherents, among them Emile de Grosz, who finds it useful in buphthalmos.

It was left to La Grange to solve the problem, which he effectually did with his well known operation which, first performed in 1903, was described in 1905.

In 1907 Herbert published an account of his wedge-isolation operation, which is a safe and fairly reliable method of fistulization. It is to-day employed by not a few surgeons, among them by Jameson Evans and Wilfred Allport of Birmingham. I have seen a large number of the results obtained and they are in the main thoroughly satisfactory, so much so indeed that one marvels that the distinguished inventor has abandoned the operation himself in favour of other procedures, some less effective, others reactionary and dangerous.

In 1908 Holth began to use a punch to obtain a filtering scar, and in July, 1909, he published an account of his well known operation.

On January 5, 1909, Freeland Fergus performed his first operation with the trephine, and in July, 1909, he described it to the Ophthalmological Congress at Oxford. Later on in 1909 he read a communication on the subject to the annual meeting of the British Medical Association at Belfast.

In December, 1909, Elliot published in the *Ophthalmoscope* a preliminary communication upon the use of the trephine in glaucoma. This operation has been developed and improved by Elliot, who had the advantage of the almost unlimited material afforded by an Indian ophthalmic hospital, and is at the present time more widely adopted than any other for the treatment of chronic glaucoma. It is performed by the majority of ophthalmic surgeons in the British Empire, in the United States, and in many other countries. Many trephine for all varieties of the disease, including the most acute forms. If correctly performed the trephining operation yields excellent results, and probably if adopted early in the disease will effect a cure in about 75 per cent. of the cases. As a matter of fact my own statistics give this figure for all cases of glaucoma simplex.

In Germany and some other Central European countries trephining has lost ground, and there is a strong tendency to revert to iridectomy. Two causes have contributed to this reaction. The War has given a distaste for operations which were wholly devised in enemy lands, and the liability to late infection, which seems to have been unduly frequent in Germany, has made the operation unpopular. At first the trephine operation was well received in Germany, and among others, Stock was warm in its praise. Soon, however, case after case of late infection was reported: Kuhnt, Axenfeld, Harms, Schur, Stoewer, and others being among the sufferers. In consequence there is a prejudice against the trephine, and Meller, Haab, and others, have given it up as a routine operation, and reserve it for a few exceptional cases. Heine's cyclodialysis is now preferred, and even for the chronic form of glaucoma, iridectomy would appear to be the most popular operation in Germany.

A critical study of the literature relating to the modern fistulizing operations leads to the conclusion that there is almost a consensus of opinion that these procedures are more efficient in reducing hypertension than iridectomy, but that the danger of late infection is a serious offset which has deterred many from adopting sclerostomy, and has driven them to older and less efficient operations. There seems even to be a tendency to revert to the middle ages of ophthalmology and to trust to miotics and abandon operations in glaucoma simplex. Asmus, in a paper entitled "Für und wider Elliot," takes a more sensible view. He finds that the results which he has obtained from the trephine are so superior to those following older methods, that he says we must not abandon the better method but must seek out and avoid the causes which tend towards late infection and by an improved technique eliminate the defects which predispose to it.

It is at once obvious that every case should be carefully worked up and recorded in detail in order that others may recognize the clinical features and be acquainted with those slight errors in operating which conduce to failure.

It has been my misfortune to have treated nine patients (eleven eyes) who have suffered from late infection. Of these nine patients, seven were operated upon by me. In August, 1915, I published in the *Ophthalmoscope* eight of these cases under the title, "The Tragedy of Sclerostomy." Some of these original patients have had a second or third attack and two more have appeared. At the time I was so disgusted with these real tragedies that I abandoned sclerostomy and reverted to iridectomy. I carefully recorded a series of iridectomies and found that the results were so futile that a change must be made. I reverted to the trephine, and a comparison of my later results afforded such a conclusive vindication of the fistulizing method that I shall never again perform iridectomy for glaucoma simplex. My statistics show that at most 45 per cent. of iridectomies are successful whereas sclerostomy yields about 75 per cent. of good results. During the years 1918 and 1919 I trephined forty eyes for glaucoma simplex and till recently all were successful. Two have reappeared with raised tension and have been retrephined with success.

After a lapse of five years I am now able to review my cases of late infection in a better perspective and to study them with a judicial mind. My late infections have all followed the trephine operation and Holth's punch operation, I shall consider them under these heads :—

(1) *Cases following the Use of the Trephine.*—I have collected the notes of 160 operations, most of them trephined by myself, or by my house-surgeons acting under my supervision. Among these 160 operations there have been three examples of late infection, all of the mild type. The details are shortly as follows :—

W.—Both eyes trephined in 1911 by Mr. Jameson Evans at the Birmingham Eye Hospital. One eye showed a mild late infection in 1920, nine years after the operation. As a result the filtration ceased and the tension has remained at 40 Schiötz units. The eye has been retrephined.

J., an alcoholic woman. Trephined by me in 1919. Late infection seven months later. As a result filtration has been abolished and a re-trephine will be called for.

F.—This man had lost one eye from a late infection, which followed the punch operation and will be described later. In February, 1916, the remaining eye was trephined by Lieutenant-Colonel Elliot at the Birmingham Eye Hospital. Six months later I found pus in the lacrymal sac and excised it. In 1920 a late infection set in but complete recovery took place. There was no pus in the sacs at the time of the two operations, but there is little doubt that the eyes were infected from the nose. The lacrymal sac on the side of the lost eye never contained any pus.

In all these three cases there was no error of technique in the operation and in the first two no cause was detected for the inflammation. These three infections amounted to less than 2 per cent. of all the operations. The net result is that among 160 trephining operations there was no loss from late infection, but that three eyes suffered, and that two of them will have been submitted to a second operation. Here then we have no cause to speak of the tragedy of trephining.

(2) *Cases following the Use of Holth's Punch.*—I have eight examples of late infection after the punch operation, which I have performed forty times. This gives a percentage of 20. Of these, three eyes were total losses. Thus forty operations yielded 7·5 per cent. of total loss and 12·5 per cent. of milder infections. The details of the cases are the following :—

H., an alcoholic female. Normal operation in February, 1914. In May, 1915, fifteen months after the operation, the patient appeared with the eye in a state of acute panophthalmitis. She stated that she had had "ulcers" on the lid for a fortnight and that then the eye "suddenly went wrong." The eye was eviscerated.

Here we have a clear case of infection from the outside, probably with a staphylococcus.

F. Operation in April, 1915. He was a bad straining patient and a little vitreous was lost. A week later the anterior chamber had not re-formed and there appeared to be a minute orifice in the conjunctiva. For a month the tension remained at 30 Schiötz, but then it fell to 7, and the eye was hypotonic for two months. The fields of vision increased in size, and vision improved from $\frac{6}{24}$ to $\frac{6}{12}$. In November, 1915, six months after the operation, F. appeared with a late infection. He stated that the eye had been painful for four days. There was a white area over the punch hole and flakes of lymph on the iris. After a month's treatment the eye was quiet, but there was iris bombé, and no useful vision. As I considered that it might cause sympathetic ophthalmitis, I removed it. Later, as already described, the second eye was trephined by Colonel Elliot and also suffered a mild late infection.

In this case there was a clear source of infection, although at the time there was no sign of it. In August, 1916, I found pus in the sac on the opposite side and excised it. The operation was not a normal one for there was loss of vitreous and there appeared to be a hiatus in the conjunctiva covering the aperture.

J. In February, 1914, the right eye was operated upon with the punch. A small button-hole was made in the flap and was sewn up. In March there was no sign of any hole in the conjunctiva, the scar was flat and there was no sign of ectasia. Filtration was good, and the tension was normal. Vision had improved from hand reflex to counting fingers.

In April, 1915, the eye became painful and patient reappeared. I found that there was a small regular bleb with no sign of any weakness in the centre. The eye was intensely injected and there was a hypopyon. Under treatment the eye became quiet, but it was soft and had no useful sight, so I removed it.

Here again there was an error in technique. The flap was button-holed, and, although there was no sign of it later on, it is probable that there was a weak spot which allowed organisms to enter the eye. The second eye was operated upon at about the same time with a permanent good result. The patient was last seen in April, 1918.

These three patients all lost the eye, and one of them nearly lost both. One was an alcoholic, and the other two had abnormal operations. In all, three of these cases are noted as alcoholics.

Fg. In January, 1914, both eyes were trephined for chronic glaucoma. The right eye was nearly blind from glaucoma simplex which, quite unknown to the patient, had advanced till but a peripheral islet of the field was left. This eye had never given any further trouble nor has the islet of visual field contracted further. The left conjunctival flap was button-holed at the operation and there was no restoration of the anterior chamber for two weeks. The result was a good one, but there was a dark thin area in the centre of the scar.

In June, 1915, there was a severe attack of late infection which took the form of an irido-cyclitis with much muco-purulent discharge. Complete recovery took place. In October, 1915, there was a second milder attack. In November there was a third attack of a mild iritis.

All went well for five years. The field was normal, vision $\frac{6}{9}$, and the tension was normal.

In June, 1920, she got up perfectly well, but during the morning the eye rapidly began to get painful and a discharge appeared from the lids. I saw her the same day. I found an acute muco-purulent conjunctivitis with engorgement of the vessels round the aperture. This was covered by a yellow œdematous conjunctiva. There was loss of iris gloss and visible engorgement of the iris vessels. There were small synechiæ round the pupil and the whole cornea was hazy. The conjunctivitis proved to be resistant to treatment although the discharge showed no organisms. Ultimately the eye settled down, but the lens has become cloudy, and vision in the only seeing eye has sunk to $\frac{6}{60}$.

In this case the onset of the iritis and of the conjunctivitis appears to have been simultaneous.

G. This lady had lost an eye which was removed by Mr. Pooley because it contained a tumour. The remaining eye was affected with glaucoma simplex. In June, 1914, it was operated upon with Holth's punch. A year later the tension was subnormal, but cataract was slowly developing as a nuclear haze. The scar had become ectatic.

On June 4, 1915, Mrs. G., came up again because her eye was red. The scar was milky white and gave the impression that a mould was growing upon it. There was no sign of iritis, but the eye was injected. This condition rapidly cleared up. Examination showed that the scar was actually infected with a saprophytic mould which grew on culture media as a green colony. It was submitted to the Professor of Botany at Birmingham University. The fungus was stated to be *Mucor septatus*. This fact appears to be of great importance, for if a saprophytic mould can grow upon the conjunctiva it is evident that it has been profoundly modified, and in a sense devitalized by the long-continued œdema.

In July, 1916, a year later, there was a relapse of the infection. Again a white colony was seen on the conjunctiva over the aperture. This time no mould was found and the organism was *Staphylococcus albus*.

December, 1916 : A third attack of the same type was easily cured, but it left a flat scar with total abolition of the bleb, which had grown smaller after each attack.

In February, 1919, the tension rose and remained at about 50 Schiötz. In March, 1919, the eye was trephined again. At the present time, nearly seven years after the first operation, the eye is quite soft, and shows no sign of glaucoma. The sight is poor because the cataract has grown denser. It is possible that I may yet remove the lens, perhaps with return of useful vision.

L., an alcoholic female, was trephined in April, 1913, for glaucoma of a subacute type. In September she was stung on the lid by a wasp. A mild infection followed. The result was closure of the aperture with cessation of filtration.

S. Holth's punch operation in January, 1914. In November, 1914, there was a severe local infection of the scar, with great pain and irido-cyclitis. A complete recovery was attained, but there was a tendency for the tension to become raised in spite of a large filtering bleb.

H. As stated above, the right eye was lost from an acute panophthalmitis. The left eye was punched in February, 1914. The patient, an alcoholic, excitable female, behaved badly at the operation, and a drop of vitreous appeared in the aperture. The flap was not sutured. Two days later, when the eye was dressed for the second time, the flap was seen rolled back over the cornea, and had to be sutured in place. The result was satisfactory, and when last seen the eye was still useful with vision $\frac{6}{18}$. In June she came up with an acute iritis which yielded to treatment. The site of the operation was inflamed and yellowish.

Conditions which favour Late Infection.—A study of the cases cited makes it abundantly clear that the trephine operation is not one which furnishes a large percentage of examples of late infection. In 158 operations I have only thus suffered once, and the eye made a good recovery. If I include the two other cases of my own in which the operation was performed in the most admirable manner by colleagues, we get but three cases in 160 operations, and not one led to the loss of an eye. I have no example in my series of an eye lost from late infection after the trephine operation. After the punch operation the case is widely different. In forty operations three eyes have been totally lost, one seriously damaged, and four others have experienced milder attacks. It is at once obvious that the scar left by the punch is far more vulnerable than the trephine scar. Probably there is more bruising, and in at least one case the flap was button-holed by the pressure of the punch. In consequence this operation belongs to the past. A button-hole is a serious menace and has led to more than one of my disastrous results. I rarely now make a button-hole, but in some cases the conjunctiva is so friable that it may tear. In this case it is imperative to trephine well away from the damaged area. Of course the flap must be cut as thick as possible and treated with extreme gentleness. A small bulging ectatic scar has a low vitality and is more likely to become infected than a larger cushion scar. Every effort should be made to attain the latter type, but up to the present we cannot command the ideal scar in all cases.

Hypotony appears to be one of the conditions which favour late infection. I noted it in three of my cases. In one the tension had been slightly above the normal for a long time. Then it sank below the normal and shortly afterwards the eye became infected. It may be that in this case the hypotony was part of the cyclitis, but I do not think so.

Local septic foci, such as disease of the nasal sinuses or lacrymal apparatus, are very dangerous. I never operate without syringing out the lacrymal sac.

Alcohol.—This has been a factor in many of my cases.

Nature of the Infection.—Unfortunately, owing to the War, my bacteriological investigations have been difficult and often impossible. In one case I found the mould *Mucor septatus*, in another *Staphylococcus albus*, and another was apparently sterile. I regard the *Staphylococcus albus* as a wolf in sheep's clothing and I now refuse to operate when it is present in a culture from the conjunctival sac.

Symptoms.—These have been related. There is always a local infection of the scar, and generally a smart irido-cyclitis, often with hypopyon. There is usually a severe conjunctivitis which appears to be part of the inflammation rather than the cause.

Result.—As a rule the inflammation quiets down, but frequently the scar cicatrizes and filtration ceases. In these cases the tension is apt to rise again, and the operation must be repeated. Cataract is a not uncommon complication of a late infection. In the majority of cases the irido-cyclitis clears up and the media remain clear. All degrees of inflammation are met with, and the result depends upon the severity of the attack.

Treatment.—Rest in bed. Atropine. Treatment of the conjunctivitis. Hot box.

How to avoid Late Infection.—One should get over the idea that the operation is an easy one. Cultivate a perfect technique and be as rapid as possible, consistent with good work. Cut the flap so as to include all the tissues. Avoid bruising the flap. Use sharp trephines. Suture the flap. Carefully search for any local septic focus. Use an antiseptic lotion for all time. I advise a 1 in 10,000 solution of oxy-cyanide of mercury employed nightly in an eye bath.

Conclusion.—The trephine operation is not liable to be followed by late infection. The fact that there is a gain of 20 to 25 per cent. between trephine and iridectomy far outweighs any danger from this complication.

DISCUSSION.

Mr. MALCOLM L. HEPBURN said he was under the impression that Mr. Harrison Butler intended to read a paper on late infection, thereby discouraging, what in his opinion was the best operation for chronic glaucoma, and he (the speaker) was prepared with a paper to show that late infection was not so common as he presumed Mr. Harrison Butler would say it was. But Mr. Harrison Butler seemed to have become converted in the middle of his paper, because he mentioned almost all the points he (Mr. Hepburn) had included in the paper he had intended to read. Mr. Hepburn had done 125 trephinings, and had had only one case of suppuration. At first, he was not sure whether Mr. Harrison Butler meant by "late infection" only suppuration, or whether he would include irido-cyclitis and iritis. He now gathered that all kinds of infection were included. Iritis was common after trephining, and therefore he always used atropine as a routine measure. He had intended to refer to the importance of making the flap as thick as possible, and, since Mr. Butler had also emphasized this point, he would like to withdraw his own paper.

Mr. S. H. Browning asked whether the eyes referred to in the paper were examined bacteriologically before the operation, and if so, what were the methods employed? He gathered that the author followed out Elschnig's work and method, but that did not meet with general approval. Elschnig got 694 sterile cultures out of 1,500 eyes. Mr. Harrison Butler said he would not operate again if *Staphylococcus albus* were found to be present; but that organism was found in nearly 100 per cent. of the cases at Moorfields. The author did not say whether the organisms found were pneumococci—which were very common in eye infections. If the surgeon only looked for pus, he would be led astray, because eyes which looked quite healthy were found to contain pneumococci, streptococci, and *Staphylococcus aureus* in numbers sufficient to warrant postponement of the operation. The addition of this information would make Mr. Harrison Butler's paper more complete.

Mr. Leighton Davies asked whether the author had notes as to the character of the conjunctiva in the cases in which late infection occurred. The thickness of the flap used varied very much, and he had often wondered whether a thin conjunctiva might be answerable for the occurrence of late infection. He had seen only one case of late infection in 150 operations, and he believed there was a very thin conjunctiva in that case. He operated on both eyes in that patient, but late infection occurred in only one of them. The eye quieted down.

Mr. M. S. Mayou said he regarded the thickness of the flap as a very important protection against infection, hence he made a straight incision into the conjunctiva, so that the scar tissue should not interfere with the filtration from the trephine hole into the subconjunctival tissue. Another protection against infection which had been forcibly brought home to him was the quantity of fluid which leaked out from the anterior chamber through the trephine hole. He did a double trephine for a woman, and a year later she got acute conjunctivitis, and both trephine holes became yellow with pus and slough, yet there was no infection of the anterior chamber at all, although the fluid was leaking externally. Under treatment, the conjunctivitis cleared up, and the trephine holes closed, but there was hypotony for the following eighteen months. The eyes were very soft. Three years after the operation her tension was almost normal again. He thought it probable that those eyes were saved by the quantity of fluid which leaked from the anterior chamber and kept the wound cleansed. He had had only one instance of late infection after trephining; he had seen two others, however; in all of these recovery was good.

Mr. Harrison Butler (in reply) said that he was sorry that Mr. Hepburn had anticipated a paper condemning sclerectomy operations. His previous publications upon the subject had been written at a time when he was smarting from the impression made by several cases of late infection which had followed the punch operation and not the trephine. He thought that some of the speakers had confused the slight iritis which immediately followed some operations, with late infection which occurred some months or even years after the intervention. Late infection had a definite and unmistakable symptom-complex. He was interested in Mr. Browning's remarks. He was well aware that, in order to determine whether the conjunctival sac was sterile or not, complicated methods must be adopted, methods which were too lengthy for ordinary clinical work. He was getting more and more suspicious of the *Staphylococcus albus*, and he now rarely opened a globe until he had obtained a sterile result from a forty-eight hours' culture on blood-agar or blood-serum. If after forty-eight hours' incubation no colonies were visible he hoped that the sac was more or less sterile. The method was admittedly not perfect but was a good working makeshift. A speaker had said that if one waited for a sterile sac no operations would be performed. This was hardly correct, for with a little patience success was usual, and but a few operations had to be done in the presence of organisms. Mr. Browning said that Elschnig's methods were wrong. If this were so, he cordially invited Mr. Browning to come to the Oxford Congress and lighten the darkness. He felt that the matter was most important and that Mr. Browning should instruct the Congress as to the best practical methods to adopt to detect dangerous organisms in the conjunctival sac. The excellent series of operations published by Continental surgeons could not be ignored; there were men recording a thousand extractions with minimal loss, and these men were most careful about conjunctival micrococci. With regard to Mr. Leighton Davies's question about the thickness and general condition of the conjunctiva in the eyes which suffered late infection; he could not answer this because the infection took place so long after the operation. On the whole he did not think that all the failures had thin flaps. In conclusion, he said that the good effects of the operations for producing filtering scars were so transcendent in comparison with those after iridectomy that they must not be frightened by a few cases of late infection. He would again emphasize the fact that he had only had one such case among the trephinings he had performed himself, and that a mild one; this among 158 operations.

Section of Ophthalmology.[1]

President—Dr. JAMES TAYLOR, C.B.E.

The Use of the Hydrophthalmoscope in the Examination of Cases of High Myopia.

By RAYNER D. BATTEN, M.D.

I MERELY show the instrument—which I have described on previous occasions[2]—in connexion with Mr. Rea's case now exhibited. By this means one obtains a detailed view with bright illumination of the fundus in an eye with even 30 D. of myopia. The instrument has many other clinical uses.

Case of Extreme Choroidal Atrophy in High Myopia, shown by Mr. Rayner Batten's Hydrophthalmoscope.

By R. L. REA, M.D., F.R.C.S.

PATIENT, a female, aged 63. Degree of myopia, 30 D.

I am using the instrument a good deal. I have always experienced great difficulty in seeing the fine changes in highly myopic fundi, and this instrument affords me great help.

Lacrymal Obstruction: The Results of the Anastomotic Method of Treatment (Toti).

By D. LEIGHTON DAVIES, M.S.

IN spite of all that has been written about the treatment of lacrymal obstruction and of all that has been done for patients suffering from it, few of us can remain satisfied with the results obtained. I have been treating these cases by the newer, or what one may term the "short-circuiting" method (or dacryocystorhinostomy) for some years past, and I propose to recount the results I have so far attained. A few remarks on the general question will precede discussion of the actual cases.

(1) *Ætiology.*—Judging from the cases published and from my own experience any obvious or gross pathological condition in the nose is rarely found, though some observers state that in these cases definite intranasal disease is common. Among the conditions I have met associated with lacrymal obstruction are: (*a*) Lupus of the nose, (*b*) empyema of the anterior ethmoidal cells, (*c*) tuberculosis of canaliculi and lacrymal sac, and (*d*) chronic nasopharyngeal catarrh.

Apart from these conditions which cause obstruction, in obvious ways, how are the great bulk of cases of lacrymal obstruction to be explained? I am inclined to regard the obstruction as due to the cumulative effects of recurring attacks of acute or subacute nasal catarrh: for I find that a very large number of those who suffer from lacrymal obstruction are very prone to "catch cold."

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[1] At a meeting of the Section, held May 13, 1921.

[2] *Ophthalmoscope*, 1910, viii, p. 92; *Trans. Ophthal. Soc. U.K.*, 1920, xl, p. 357.

(2) *Pathology.*—As a result of the acute nasal catarrh, certain pathological changes may ensue; these I would describe as follows: An ascending inflammation of the mucous and submucous tissue of the nasal duct occurs, and this leads to:—

(*a*) A transformation of the vascular submucous tissue into cicatricial tissue. This is analogous to the atrophic rhinitis which often results from chronic nasal catarrh.

(*b*) Ulceration of the mucous membrane of the duct followed by gradual contraction of the lumen due to cicatrization.

Theoretically therefore the stricture may be due to contraction from without the tube or from within; but I know of no case in which these conditions have been verified by inspection of the actual seat of stricture, and therefore all this is merely hypothetical and really of little value.

Next as to the seat of stricture. The narrowest part of the lumen of the duct is the point where it is continuous with the sac—i.e., at the upper end of the lacrymal canal; here therefore as might be expected the stricture is most frequently found. I have injected a good many cases of lacrymal stricture with a fine watery emulsion of bismuth subnitrate and had an X-ray photograph taken. In no cases have I found any shadow below the level of the sac.

Ewing published a paper in the *American Journal of Ophthalmology*, 1909, vol. xxvi, p. 1, entitled "Roentgen Ray Demonstrations of the Lacrimal Abscess Cavity," illustrated by photographs precisely similar to those now exhibited. The abscess cavities were filled with an emulsion of finely-sifted bismuth subnitrate in liquid paraffin.

The seat of stricture can also be demonstrated in cases in which the sac is opened and it will nearly always be found at the commencement of the duct.

(3) *Treatment.*—I do not intend to deal with early cases but with those in which an organic and fully established stricture is present. I am sure we all agree that such a condition is incurable apart from operation. What operations are available? We have:—

(i) *Probing.*—This old-established method has been in vogue for a great many years, but it is being condemned by an ever-increasing number of practitioners. The constant introduction of modifications of various sorts throw some light upon the unsatisfactory results obtained. At the best the method is very tedious, always painful, and permanent cures are, I believe, rare.

(ii) *Probing combined with the Retention of a Silver Tube or Lead Style.*—No doubt some successes follow this line of treatment, but it is not an agreeable prospect to pass one's life with a foreign body lodging in the lacrymal duct. On many occasions I have had to remove a lead style which had lain in or outside the duct for a number of years and had ultimately revealed its presence by the development of an acute phlegmon of the tissues around. Under the same heading can be placed Koster's method of thread drainage. This consists in passing a hollow sound through the nasal duct, through which a stout thread is passed; the sound is now removed over the thread, the thread being left in position. The two ends are tied together leaving a loop on the face. This is left *in situ* for a few weeks.

All these methods leave much to be desired, consequently *total excision of the sac* has gained a good many advocates. And from the patient's point of view excision of the sac is a great advance on the older method of probing, because:—

(*a*) It shortens the course of treatment; (*b*) it is effective in curing the suppurative trouble always associated sooner or later with chronic lacrymal obstruction; (*c*) in a large percentage of cases it affords complete relief to the epiphora.

Notwithstanding all that can be said for it, total excision of the sac is a mutilation; and the desire to try to restore the abnormal or irregular actions of the human body to as near normal as possible is inherent in us. Many years ago this desire led to the suggestion of forming a fresh channel from the sac to the nose through the middle meatus, but the proposal never attracted much attention until Toti published his first paper on what we may term the anastomotic method of dealing with lacrymal obstruction. Polyack and West amongst others subsequently dealt with the subject from the rhinologist's point of view.

As I have already said I have been interested in the subject for many years and for over six years I have been doing the operation as devised by Toti with slight variations of technique.

Before I describe the operation, I will direct your attention to the anatomy of the lacrymal fossa and its nasal relationships. The floor of the lacrymal fossa is made up of two bones very dissimilar in character. Behind is the anterior portion of the lacrymal bone divided from the orbital part by a bony ridge—the lacrymal crest—and in front is the posterior part of the frontal process of the superior maxillary bone, which is bounded in front by the continuation upwards of the orbital margin. The former of the two bones is very thin and easily broken, the latter is thick and dense. To the ridge in front and behind the fossa are attached the superficial and deep parts of the tarsal ligament respectively. On the inner side the lacrymal fossa is in relation with the middle meatus of the nose, just in front and below the anterior end of the middle turbinate bone. This, however, may occasionally be situated with its anterior extremity over the region of the lacrymal fossa. Again an anterior ethmoidal cell may lie against and may excavate the lacrymal bone or even the frontal process of the superior maxilla, and it will then lie within the lacrymal fossa.

In either of those two cases the turbinate or the ethmoidal air cell may interfere with the formation of a free passage from the lacrymal fossa to the nose. Again, owing to the differences in the character of the two bones it is easy to remove the lacrymal bone, but it is difficult, without special means of so doing, to cut through the maxillary portion.

The *operation*, very briefly recorded, is as follows: An incision is made about 1¼ in. long, beginning just above the tendo oculi and extending downward with a slight curve along the anterior margin of the lacrymal fossa as far as the infra-orbital margin. The incision should be carried right down to the bone, cutting the periosteum. The periosteum is now raised out of the fossa by a rugine and thrown outwards together with the sac; the floor of the fossa being thus exposed the lacrymal bone is broken next and removed. A punch forceps with a button-like end is then pushed in through the opening, and the anterior half of the floor of the fossa is removed by snipping away the bone: the nasal mucous membrane being removed at the same time. Enough bone is removed, extending downward to the lower end of the fossa, until the opening is large enough to admit the finger. Next, the inner wall of the sac covered by periosteum is removed. One or two stitches are now passed through the anterior and upper edge of the cut wall of the sac. A forceps is passed up through the nostril, and these sutures are taken up and drawn down through the nostril. The edges of the skin and subcutaneous tissue are now brought together by two or three stitches. Finally, the sutures in the nostril, which consist of two double threads, are tied together round a piece of indiarubber tubing at the anterior nares. These sutures serve to anchor the sac to the opening in the bone; they are removed in forty-eight hours, and after this the nose is irrigated gently with an alkaline lotion every day. At the end of a week the sac is cleansed by syringing a little saline solution through the canaliculus.

The greatest difficulty in the operation arises from the liability to troublesome hæmorrhage, but in a straightforward case the operation does not take more than twenty minutes. To lessen the hæmorrhage I inject a little adrenalin solution (1 in 4,000) into the tissues round the fossa and put a pledget of cotton wool soaked in the same fluid in the nostril.

Results of the Operation.—Up to the present I have done it in fifty-six cases. I have classified the results under three headings: (1) Complete cures; (2) partial cures; (3) failures. I consider a perfect cure a case in which after operation there is no epiphora and fluid passes easily to the nose on syringing through the canaliculus; a partial cure one in which there is no troublesome watering of the eye and yet fluid cannot be passed into the nose; and failures those cases in which watering of the eye and complete obstruction of the newly-formed passage have occurred. Upon the basis of this classification I find thirty-six of my cases to be complete cures, ten cases partial cures, ten cases failures. That is 64·3 per cent. of cures.

Now as to the causes of the failures and partial failures. They are almost invariably due to the contraction of the new opening. I only recall two cases in which the opening, though very small, is patent, and yet slight epiphora still occurs. This is really the weak point in the operation. Why this contraction occurs I am not quite certain. It may be that I excise too much of the inner wall of the sac. All cases upon which I have operated have been satisfactory for the first three to four weeks.

The only two points in favour of the intranasal route are: (1) That it can be done without an external wound, and (2) that it does not disturb the relations of the sac.

Against the operation it may be urged (1) that operation is carried out in a very confined space; this makes it difficult to see what is being done. (2) A preliminary operation to deal with a deflected septum or an enlarged turbinate is often required. (3) It is very difficult to get through the thick nasal process of the superior maxilla when working in such a confined space.

I have placed my figures before you just as they have occurred in my case book without any attempt to coax them into making a good show. I confess I am not quite satisfied with the final results which I have obtained. The immediate results are always good, but one has to wait for three or four months before being certain of a cure. I have, however, every confidence that if a case is satisfactory at the end of four months the cure is permanent, and the scar, as is the case in excisions of the sac, is invisible after a couple of months.

DISCUSSION.

Mr. A. W. ORMOND said he also had found that these cases were unsatisfactory. But, without claiming that his experience was at all common, he had found that the less he did, the better. In these cases one often found that, on pressing over the sac.

muco-pus exuded. He generally passed a small probe to ascertain whether there was real organic obstruction—i.e., if he could pass a fairly small probe through into the nose, he did not do any further probing at all. He believed that many of these cases were due to strictures which were potential, not actual—i.e., they were caused by the mucous membrane being inflamed, and by the walls of the canaliculus being adherent, or at least in contact, and so forming an obstruction by approximation, rather than by any definite stricture. After that, he generally advised the patient to continue with antiseptic treatment ; he instructed him how to press out the sac and afterwards put in antiseptic drops, containing perchloride of mercury with sulphate of zinc, continuing that for a month or six weeks. His usual experience had been that at the end of a month or six weeks the discharge, hitherto purulent, had become mucoid, and, that except for a little mucus, it was now clear. Beyond that, if there was no obstruction and yet the patient still complained of watering of the eye, which was regarded as a great inconvenience, he advised the removal of the sac. He agreed it was not an entirely satisfactory method, because there was still the possibility of the discharge becoming purulent again ; but so long as the discharge was clear and was much reduced, the patient was much more comfortable and in no danger.

Mr. MALCOLM HEPBURN asked whether Dr. Davies had experienced difficulty in finding the inner part of the lacrymal duct. In many of these cases the relationship of the parts was so altered that it was difficult to differentiate the sac from the other parts. He had not himself done this operation, which might prove to be easier than it sounded. He did not agree with Mr. Ormond's remarks about a "potential stricture"; he (Mr. Hepburn) considered congenital stenosis of the lacrymal duct in infants was a typical example of potential stricture. In the case of infants it was easy to pass a fine probe; but in chronic long-standing inflammation of the lacrymal sac it was difficult to pass the finest probe, and in such cases he thought there was always definite thickening, not only of the soft tissues round the duct, but possibly of the bone also.

Mr. W. H. MCMULLEN asked at what age Dr. Davies had operated upon most of his patients. He considered the condition in children was a difficult one to deal with compared with that in adults. In his experience, the majority of cases of congenital obstruction opened up spontaneously in the course of a few weeks or months if the contents of the sac were expressed regularly and the eye kept clean. In most of the cases which did not open up the passing of a probe once sufficed to bring about a cure. But when chronic dacryocystitis occurred later in childhood, he found it almost invariably necessitated excision of the sac ; he had passed some of the cases on to a rhinologist, asking if it was of any use doing a West's operation, and the reply had been that the parts were so small and access so difficult that it was not advised. One objection which had been raised to the Toti operation was, that the patient, when blowing the nose, was apt to blow air and nasal mucus into the conjunctival sac ; and he asked whether Dr. Davies had experienced that difficulty.

Dr. LEIGHTON DAVIES (in reply) said he regarded it as a serious thing to interfere with the nasal cavity, and he never advised a patient to have an operation of this kind unless he was very much troubled by the epiphora. People differed enormously in the degree of discomfort they experienced from this. When a case of the kind came to him he always treated it in the way Mr. Ormond described, by cleansing the sac, and the condition generally improved rapidly. He pointed out to patients that if they were careful, and saw the surgeon occasionally in order to have the sac syringed out, they might be able to go through life without an operation. But some were so worried by the constant "tearing" that they were willing to undergo anything which was likely to bring relief, and upon those he operated. He never pressed the operation, because one could not do so with the feeling that success could be guaranteed ; hence he laid some of the onus on the patient himself. He agreed that these strictures were often potential to begin with, but they always became organic in the end ; he had followed up many such cases, but he did not think they ever became bony. He had examined nearly a thousand skulls to find a constriction of the nasal canal, but in dried specimens he had not found one ; he therefore thought the stricture was always confined to the soft tissues. In answer to Mr. Hepburn, it was easy to find the sac, because the only thing on the outer side of the lacrymal fossa was the sac, and if that were picked up with toothed forceps and cut into, the sac was easily opened. If in doubt, he passed a probe into the canaliculus, and pushed out the inner wall of the sac, then it could easily be seen; the tissue to be cut away was fairly thick as it included periosteum. In answer to Mr. McMullen, he did not think one was justified in operating on a child under the age of 16 by the intranasal method; it was wrong to interfere with the parts in a growing child; in the case of children he preferred to excise the sac. In most cases infants were much better left alone; a large percentage of these got well without any treatment beyond local cleansing. Neither did he operate on old people, because in people above 60 there was apt to be very troublesome hæmorrhage; vessels were opened up which did not readily contract, and, moreover, their expectation of life was not great, and he advised them to try to tolerate the inconvenience. The cases he preferred for operation were young or middle-aged adults who found the epiphora an intolerable nuisance. The liability of contamination by air and mucus when the nose was blown was an objection which had been urged in regard to all these operations, but he had never seen nor read in the literature of a case in which it had occurred, therefore he regarded it as a mere theoretical criticism.

A Specimen of Congenital Aphakia occurring in a Human Embryo of Five to Six Weeks.

By I. C. Mann, M.B., B.S.

(ABSTRACT.)

CASES of congenital aphakia are excessively rare apart from gross degrees of microphthalmos, and indeed the question has been raised as to whether they occur at all in otherwise normal or nearly normal eyes. It is on this account that the following case of failure of development of the lens in an otherwise normal human embryo is reported.

The embryo, which is about the 13 mm. stage (i.e., between the fifth and sixth weeks), was compared with another human embryo of the same stage known to be normal. The optic cups of both were of approximately the same size (0·5 mm. in diameter), but while the normal embryo showed a well developed lens vesicle entirely separated from the ectoderm, the abnormal embryo showed no trace of a lens in either eye except that in the right eye there was a small blunt-pointed projection from the deep aspect of the surface ectoderm almost in the centre of the pupil. This probably represented an abortive attempt at lens formation. (Slides were shown demonstrating the formation of the lens in normal human embryos at various stages, together with the aphakic eye of the abnormal embryo.)

DISCUSSION.

The PRESIDENT said that Miss Mann had shown an exceedingly interesting and very perfect piece of work of a unique nature, and asked of what material the ingenious model exhibited in connexion with the specimen was made.

Mr. AFFLECK GREEVES said he had had the opportunity of examining microscopically many congenitally abnormal eyes, including microphthalmic eyes, but in all cases there had been a lens, or at least a lens capsule; he had never seen one in which there was no trace of a lens.

Miss MANN (replying to the President) said the model, which represented the aphakic eye × 200, consisted of paraffin wax plates 1 mm. thick, and it was made from drawings of serial sections by the method usually followed in the Anatomical Department of St. Mary's Hospital.

Section of Ophthalmology.[1]

President — Dr. JAMES TAYLOR, C.B.E.

A Lid-lifting Speculum.

By R. WALLACE HENRY, M.D.

IN order to prevent the constant risk of a patient involuntarily pressing the eyelids together, when an opening has been made into the eye, thereby causing a loss of vitreous, I have had a new speculum constructed, and in my own experience it has absolutely removed this danger.

From each arm of a modified Lang's speculum an extension is carried, that from the upper arm being longer and more curved than that from the lower arm. The extremity of the upper extension rests on the orbital margin above, and that from the lower extension on the edge of the orbit below. Through the end of each extension runs a rod which by a screw adjustment enables the arms of the speculum to be raised from the eye. A similar rod and screw at the junction of the arms raises the outer part of the speculum in like manner.

The result is that it is impossible for the patient to exercise any pressure on the eyeball.

Mr. J. HERBERT FISHER said that many surgeons might try this instrument under varying conditions. It seemed to be an easy way of getting over a serious difficulty and as it would also favourably affect the surgeon by giving him a feeling of security, it would probably prove of advantage to the patient both directly and indirectly.

A Reading and Writing Desk for Myopes and those predisposed to Myopia.

By FRANK MOXON, O.B.E., M.B., B.S.

THIS desk (as illustrated) I have designed to enforce children, who are either myopic or tend to become so, to assume a correct deportment when sitting at a table or desk to read or write.

Many children habitually apply their eyes too close to their books, and all oculists insist that this habit should be corrected.

The desk is made so that it may be adjusted either on a flat table or a sloping desk. The book is placed on a rest at a fixed distance behind a vertical glass screen, through which it is to be read; and a horizontally placed glass screen which comes to the edge of the table, is at a fixed distance from the table or desk top, and enables the hands to be rested underneath for the purpose of writing or drawing, but prevents the eyes being applied closer than the screen.

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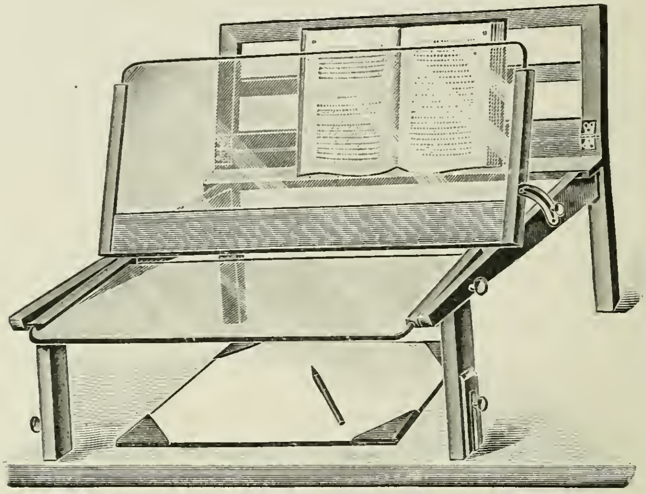
[1] At a meeting of the Section, held June 10, 1921.

Providing the chair on which the child sits is adjusted to the correct height (an important item) the whole deportment of a child when using the desk is admirable, and a pleasure to see; moreover it quickly breaks the habit referred to above.



Primary (Acute) Macular Disease.

(I) By Rayner D. Batten, M.D.

Case I.

G. P., male, aged 36. First seen April 28, 1921. On April 24 smoked heavily; following morning noticed defect of vision in left eye. Vision: Right, with glasses, + 3·5 sph. = $\frac{6}{6}$, J 1. Left, with glasses, + 3·25 sph., − 1·5 cyl., = $\frac{6}{60}$, < J 12. Pupils equal and active. Tension normal. Visual fields: Positive central scotoma in left eye.

Fundus Examination.—Right eye: Fine pigment changes at macula; between macula and optic disc superficial choroidal retinal changes. Left eye: By indirect examination, macula appears as very dark spot; by direct examination, definite pigment spots appear on an area of choroidal thinning. Pigment changes have extended over slightly wider area since first observation.

Referred to physician: Report negative. Heart, lungs, abdomen, central nervous system, and urine, all normal. Then referred to throat specialist, who reported (1) deflected septum, (2) hypertrophy of turbinates, (3) ethmoidal suppuration.

Operation May 11.

June 6.—Vision: Right eye $\frac{6}{9}$, $\frac{6}{6}$ partly; left, $\frac{6}{18}$.

Fundus Examination.—Changes in the right eye are less distinct, whilst those in the left are approximately the same. Ophthalmoscopically, there is an evident resemblance between the fundus changes in this case and those found in the familial group. I have seen the patient's brother and sister, but do not find any definite macular change in their eyes.

CASE II.

V. B., FEMALE, aged 28, unmarried. First seen April 14, 1921. Complains of loss of sight in left eye, first noticed a few weeks ago; no pain; no history of illness. Vision: Right $\frac{6}{9}$, $\frac{6}{6}$ partly; J 1. Left, $\frac{6}{60} <$ J 12.

Fundus Examination.—Right eye: Optic disc normal; marked pigment changes at macula and in macular area. Left eye: Optic disc normal and of good colour; no macular changes detected; no evidence of retrobulbar neuritis.

April 18.—Vision: Right, $\frac{6}{5}$; left, $\frac{6}{36}$. Visual fields: No constriction nor central scotoma for colours; right macular region thickly dotted with retinal pigment disturbance; pale area in macula. Left eye: Slight œdema of macula; fine line of pigment just outside macula.

Kept under observation: Vision in left eye improved, but varied from time to time; changes in macular area increased considerably.

May 26.—Vision: Right eye, $\frac{6}{6}$; left, $\frac{6}{12}$, $\frac{6}{9}$ partly. Changes in left macular region were then very extensive; dotted superficial pigment, with thinning of choroid, one thinned choroidal area extending to superior artery; a small similar area above the vessel.

Referred to physician: Report negative; heart, lungs, abdomen, central nervous system and urine, normal; no focus of sepsis found. Teeth good. Wassermann negative. There is, however, a history of purulent vaginal discharge, and, failing other evidence, I am inclined to consider this case as gonorrhœal in origin.

I have not obtained any history that this belongs to the family group. She is only 28, but is becoming distinctly grey-haired.

The main interest in this case is that the whole of the changes in the fundus in the *right* eye have developed under observation, beginning with a very fine pigment change in the macula. It will be a matter of interest to see in what group it will terminate, whether it will settle down into a more or less limited macular condition, or develop into a widespread retino-choroiditis. It is also of interest to note that the greatest defect of vision occurred whilst there were no fundus changes in the right eye, and that as the visible changes progressed the vision improved.

(II) By W. H. McMULLEN, O.B.E., M.B., F.R.C.S.

FUNDUS CHANGES IN THREE BROTHERS CHARACTERIZED BY ABNORMAL FORMATION OF CONNECTIVE TISSUE.

(1) T. T., AGED 21. Has had trouble with his eyes since 6 years old. First seen 1917; since then no appreciable change in condition of eyes. General health good. Suffers from migraine, but attacks are less frequent than they used to be.

Present condition: Right vision, $\frac{6}{24}$ partly, with + 1·5 cyl., ax. 15° = $\frac{6}{24}$: left vision, $\frac{6}{36}$, with + 1 sph. + 0·5 cyl., ax. 90° = $\frac{6}{24}$ partly.

Ophthalmoscopic Appearances.—Right eye: Retina in macular region shows slight loss of transparency and faint suggestion of fine superficial network of connective tissue. Peripheral transparent detachment of retina all round; in some places detached retina presents a marbled appearance owing to irregular network of white tissue. Left eye: Fine membranous opacities in lower part of vitreous. All central part of retina appears slightly opaque; macula has distinctly mottled appearance produced by white network on bright red ground. Peripheral detachment of the retina all round, transparent for the most part, but opaque, grey and pigmented over considerable area below.

(2) C. T., aged 16. First seen January, 1920, when he said sight had become worse during the past two years. No appreciable change since then. General health good. On one occasion after extraction of three teeth at 5 p.m., bleeding continued for several hours, and had not quite stopped when he awoke the next morning; hæmorrhage does not seem to have been alarming.

Present condition: Right vision, $\frac{6}{24}$ partly, with $-0{\cdot}5$ sph. $+1{\cdot}5$ cyl., ax. 90° $= \frac{6}{12}$ partly; left vision, $\frac{6}{60}$, with -1 cyl., ax. 180° $= \frac{6}{36}$.

In both eyes maculæ present finely mottled or stippled appearance, as if overlaid by a fine connective-tissue network; above and below discs there is marked retinal striation, especially in the neighbourhood of the vessels. In right eye a little external to macula is a long fine vertical white line of connective tissue, lying upon the retina, and slightly raised above its surface, like a very fine retinitis proliferans. Peripheral part of retina on temporal side appears covered with a fine veil of connective tissue, containing a few minute reddish flecks—apparently hæmorrhages.

(3) F. T., aged 10. Defective vision since infancy. First seen January, 1920. Fairly high degree of compound myopic astigmatism in both eyes; myopia has since increased slightly; in other respects the condition is unchanged. General health good. Has had several teeth extracted without trouble from hæmorrhage.

Present condition: Right vision $< \frac{6}{60}$, with $-8{\cdot}5$ sph. $-1{\cdot}5$ cyl., ax. 10° $= \frac{6}{36}$; left vision, $< \frac{6}{60}$, with -6 sph. $-2{\cdot}5$ cyl., ax. 30° $= \frac{6}{36}$ partly.

Right eye: Strand of delicate translucent connective tissue extending from disc nearly to posterior surface of lens; no trace of blood-vessels visible. Macula shows faint pale marbling. Left eye: Large fine membranous opacity in the upper outer part of vitreous; numerous smaller opacities; macula appears pink with slight haziness of surrounding retina.

Family history: Father and mother living, have good eyesight. They had thirteen children—nine sons, four daughters:—

(1) Male, died, aged 5½, of "water on the brain."
(2) Female, aged 30; good eyes.
(3) Female, aged 28; good eyes.
(4) Male, aged 27; not seen, living in China; "very short-sighted."
(5) Male, died, aged 2½, of "water on the stomach."
(6) Female, aged 23; good eyes.
(7) Male, aged 22; good eyes.
(8) Male, aged 21; eldest of patients shown.
(9) Female, aged 20; good eyes.
(10) Male, died, aged 3, of blood-poisoning, "due to lumps in neck."
(11) Male, aged 17; second of patients shown.
(12) Male, aged 15; eyes good, slightly deaf in one ear.
(13) Male, aged 11; third of patients shown.

Thus of nine sons three died young, while of the surviving six, three, possibly four, have their eyes affected. Three great-grand aunts on the mother's side died blind; cause of blindness unknown. No other history of eye trouble in the family.

Although the ophthalmoscopic appearances in these three patients' eyes differ considerably in detail, the essential change in all appears to be an abnormal development of connective tissue either in the vitreous—giving rise to strands, fine membranes or small opacities—or on the surface of the retina. The detachment of the retina in the first case is almost certainly secondary. All three have defective visual acuity attributable to changes of similar character but varying degree in the macular regions.

Four possible causes suggest themselves: (*a*) Chronic inflammation, (*b*) degeneration, (*c*) developmental defect, (*d*) intra-ocular hæmorrhages. The last appears to be the most probable. The changes resemble those seen in retinitis proliferans, though they are very much finer than those commonly occurring in that disease; in one eye there are some minute red spots which look like hæmorrhages; in one patient there is a definite history of slightly troublesome bleeding after extraction of teeth.

(III) By G. WINFIELD ROLL, F.R.C.S.

CASE SHOWING MACULAR CHANGES.

THIS patient has a circular plaque of what appears to be organized fibrous tissue in the macula of each eye, with symmetrical changes. He has complained of failure of sight during seven years, more definitely so in the last two years. The field of vision for white and red is practically normal, but he hardly perceives yellow and green at all. There is no history of traumatism, except his proximity, on one occasion, to a falling bomb. There is nothing in his history to afford any guide as to ætiology. As a boy he was an excellent game shot, and has driven motors; therefore, until vision began to fail, he must have had good sight. When I first saw the case I was struck by its resemblance to the cases of the Tay-Sachs disease which Waren Tay described, but they were confined to infants of the Jewish race. This patient is a corpulent, heavy man, weighing 18 st. I have never seen changes in the macula similar to his. In one eye there may be a hole in the fibrous tissue, but in the other eye there is no central aperture. I shall be interested to hear suggestions as to ætiology and treatment.

DISCUSSION.

Mr. RAYNER BATTEN said that primary macular disease should be recognized as a distinct entity, apart from other forms of choroidal retinitis involving the macula. By *primary*, he meant when the first evidences of disease occurred at the macula. In his experience, it was mainly a disease of adult life, occurring in apparently healthy subjects, and not associated with those forms of disease which usually gave rise to choroido-retinitis. These sporadic cases must be distinguished from the various forms of *familial* disease, which occurred mainly in infancy, childhood and adolescence. The familial cases were now well recognized, and there was a fair amount of literature on the subject. Primary acute macular disease was characterized by a more or less acute onset, with or without failure of vision. In some cases, it was heralded or accompanied by conjunctivitis, or a mild form of scleritis. *Acute* was a comparative term: the onset period might extend over some weeks. During this period, little or no change might be observed ophthalmoscopically. There might be some œdema of the macula, but, under present methods of observation, it was very difficult to be certain of this. Changes at the macula then became visible, and might extend beyond the actual macular area.

These might alter rapidly and then tend to subside, leaving some central macular pigmentation or change. Failure of vision might be acutest at its onset and there might be some recovery of vision during the stage when the ophthalmoscopic changes were most obvious. The final stage, as regarded the vision, might leave a central scotoma, or central vision might recover almost to the normal, though it would probably be displaced outside the true fovea. Or the disease might progress, and give rise to a more or less wide-spread choroido-retinitis. The causes of the disease had yet to be determined, but the balance of the evidence was in favour of a toxæmia. Mr. Batten had obtained histories of more or less remote causes, such as pyorrhœa, suppuration of nasal sinuses, gonorrhœa, and other septic causes, influenza and pregnancy.

Mr. J. H. FISHER said that in Mr. Roll's case there was, on the anterior plane, a mass of organized fibrous tissue lying in front of the macula, and such a mass could only have been produced by some lesion of, presumably, toxic nature, and irritative character. Whether there had been hæmorrhage antecedent to it, he did not know. He did not think the case was comparable to those described under the name "Tay-Sachs disease." The red centre was on a posterior plane, and a definite parallax was obtained through the centre of it. In Mr. McMullen's cases, it was of interest that the only occurrences of this fibrous tissue were in male members of the family; and he thought that if it were not a developmental condition, it had probably been preceded by hæmorrhage in the way the exhibitor suggested. Mr. McMullen had not given any indication of a tendency towards hæmophilia in any other members of the family, but the fact that the female members had escaped suggested a possible line of inquiry. With regard to Mr. Batten's cases it was desirable not to confuse these conditions more than was necessary, and he thought that the cases in which there was definite optic atrophy with macular degeneration might be of a degenerative character, and reasonably comparable, in the first instance, with the Semitic cases in early infancy, usually passing to a fatal termination; and the other group might be allied to that which came on later in life, though still in childhood, and did not end fatally. In the other cases Mr. Batten showed, a toxic cause would be presumed. With regard to these, he suggested that Mr. Batten, in his enthusiasm for conditions in the macula, should not disregard other portions of the fundus, because in the fundi which the speaker had seen on that occasion there were peripheral changes of a pigmentary character in the retina, also involving the choroid in outlying portions of the fundi. Thus while there might be an extreme vulnerability of the macula to toxic causes, whether from air-sinuses, genital tract or post-febrile conditions—and in some of the instances there might be a macular change of that origin without peripheral change—in others, the speaker thought, there was a more general retinitis, or choroido-retinitis than Mr. Batten had led members to think.

Mr. R. R. CRUISE said he had had a case similar to that shown by Mr. Roll, under his own observation for the last ten years. The patient was a girl, and the condition began in her seventeenth year; he first saw her at Westminster Ophthalmic Hospital. The right macular change began with a quiet-looking œdema and ultimately became very like that in Mr. Roll's patient. There was the formation of a hole, and a blood-vessel could be seen entering, or leaving the hole. There was a pit in the centre, which was dark, and the periphery was becoming pigmented. Her sight was less than $\frac{6}{60}$. A similar appearance developed in the fellow eye. Mr. Batten had suggested that in one of his cases there was more visual disturbance than the ophthalmoscopic appearance seemed to warrant, and that had been a feature of his case also. He had seen only a slight stippling in the macula, but her sight was very defective—subsequently an œdematous, somewhat pale-looking area developed which was now completely pigmented over, and, on seeing it in its present state the pigment might be imagined to be of hæmatogenous origin. He thought that cicatrization had occurred. He regarded the case as of a toxic origin, but he could not find any toxic cause, unless it were tubercle; she was treated with tuberculin for some time, but the evidence of the disease was not definite. At the time she was carefully examined in various ways, and the Wassermann was negative. He had had two other cases in private since the war; in each Dr. Matthews had found the dysentery or the paratyphoid bacillus and there was distinct improvement on vaccine-treatment.

Unusual Condition of Iris.

By IDA C. MANN, M.B., B.S.

THE patient, S. H., female, unmarried, aged 58, has been blind in the right eye as long as she can remember. She had small-pox at the age of three weeks and the right eye was affected, but there are no details as to the condition. She was seen at Moorfields when 11 years old. She has never had any operation on the right eye. The sight of the left eye had always been good until two years ago, when she developed a cataract and a preliminary iridectomy was performed.

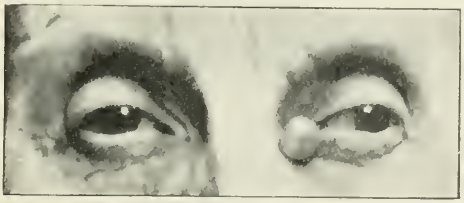
The right eye shows extreme atrophy of the iris in two sectors, one extending upwards and outwards and the other downwards. The iris is so thin in the affected regions that the dislocated and opaque lens can be seen through. The uveal pigment of the iris is absent in the affected areas, but the stroma can be seen continuous over the gap.

Mr. J. HERBERT PARSONS said that the absence of uveal pigment in this case was of interest. Members perhaps were not aware how frequently iris pigment might be absent without the fact being revealed by ordinary methods of examination. Some years ago the late Mr. Coats published a case of traumatism in which he demonstrated absence of pigment at the back of the iris, over certain areas. Recently, as described in the *British Journal of Ophthalmology*, May, 1921, p. 212, Mr. Basil Graves had been using a method of illumination by contact, similar to a trans-illumination, and in a considerable number of cases of traumatism there were seen to be patches in the iris from which the retinal pigment epithelium was absent. This fact would, in most cases, escape observation by ordinary oblique illumination and examination by means of the mirror.

Cyst of Moll's Gland of Unusual size.

By M. S. MAYOU, F.R.C.S.

MRS. W., aged 66, has had a cyst for twelve years. It is situated on the lower lid margin at the inner canthus. It is translucent and obviously contains clear fluid.



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Section of Otology.

President—Sir CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., M.S.

Introductory Remarks.[1]

By Sir CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., M.S. (President).

TWENTY years ago I read a paper at a meeting of the Royal Medical and Chirurgical Society,[2] on the "Epithelial Grafting of the Mastoid Operation Cavity," the object being to obtain the immediate healing of the bone wound. I show you the first sketches made about twenty-one years ago to illustrate the operation. The paper was discussed (amongst others) by Dr. (now Sir William) Milligan, Mr. Secker Walker, Dr. (now Sir James Dundas-) Dundas Grant, Dr. William Hill, Sir William Dalby, and Mr. Cumberbatch. I have mentioned this paper because I have shown this afternoon two cases which illustrate the advantages urged twenty years ago of immediate healing of the bone wound. One patient among these cases had had nine operations before I operated on him. My bone operation was not necessarily better than those which had preceded it, but the epithelial grafting prevented further infection of bone and healed the wound.

In regard to the progress of aural surgery in our country. What is now required is not talking and discussion, but action. Before the war men who wanted to learn otology streamed through London to Continental clinics. If in London something is not done for those seekers after knowledge the stream may set in the reverse direction and end in America. I am speaking now of this city. I look forward hopefully to the foundation of a great Central Institute of Otology of London, not to fuse or control individual clinics, but to co-ordinate and strengthen the work of teaching and research. Teaching and research.

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[1] At a meeting of the Section, held November 19, 1920.

[2] *Med. Chir. Trans.*, 1900, lxxxiii, p. 125 (Discussion, p. 173).

should go hand in hand, for a teacher who does no research does not inspire his pupils.

As to the individual clinics, I hope that before long they may be run on the unit system with Government grants for whole time men. This would strengthen and endow the work of teaching and research and would add immeasurably to the reputation and usefulness of our work.

We are, I believe, only on the threshold of knowledge of diseases of the ear. We seem to have made progress in the treatment of suppurative diseases, but the internal ear presents problems in physiology and pathology and treatment which so far have eluded the most sagacious amongst us. Our labours will not be finished in any sense while complications which we look upon now as fatal are still fatal, and while the deaf still remain deaf.

Lastly, I have one good piece of news to report to you: the Council this afternoon have decided to memorialize the two Royal Colleges to grant a diploma in Otology.

Chronic Catarrhal Otitis Media: Some Thoughts and Suggestions.

By Sir WILLIAM MILLIGAN, M.D.

THE brilliant results obtained from operative interference in the treatment of suppurative affections of the temporal bone and the various intracranial complications which so frequently follow in its train have undoubtedly thrown into the shade the treatment of that exceedingly common and troublesome form of middle-ear disease usually designated "adhesive catarrh." We aurists are however face to face every day of our lives with cases of so called "chronic catarrhal deafness" which, if not serious from a life point of view, are nevertheless serious from the point of view of the preservation of the function of hearing.

What is the clinical course of chronic adhesive otitis media in so many of our patients? Slow but progressive deafness—perhaps some intermittent treatment with slight improvement, followed by a gradual loss of hearing until finally resort has to be made to some form of artificial aid or to lip-reading. I have painted a dismal picture, for in my opinion there has been no really substantial progress in the treatment of chronic adhesive catarrh during the past twenty years.

Speaking in general terms the essential pathological changes in adhesive catarrh may be classified as follows: (1) Surface epithelial changes; (2) connective tissue changes, hypertrophic and sclerotic; (3) atrophic changes. All of these may occur separately or collectively.

So far as our knowledge goes the principal cause of chronic adhesive catarrh is repeated attacks of exudative catarrh of the tubo-tympanic mucosa, the result mainly of nasopharyngeal catarrh, nasopharyngeal adenoids, and catarrhal conditions of the upper respiratory tract. The neglected exudative catarrh of early life is *facile princeps* the main cause of chronic adhesive changes in after life. In the early stages the tympanic epithelium is red and moist, later on thickened, and in the advanced stages of the disease atrophied.

The most noticeable changes are found where the tympanic mucosa is naturally thickest, where its glands are most numerous—viz., in the Eustachian tube and around its tympanic orifice, where stenosis is apt to be at its worst and where the normal and physiological ventilation of the middle ear is most interfered with.

The exudate which is at first poured out may or may not be absorbed. In many cases it is not entirely absorbed but is sufficiently so to permit of a fairly complete restoration of hearing.

The hypo-tympanum serves as a reservoir for a certain amount of residual secretion which while out of sight is too frequently also out of mind, a secretion which acts as a foreign body, a gentle but continuous irritant, the focus of a possible future infection. In time the result is the production of a small tuft of organized connective tissue, an intratympanic buttress, which causes a blocking or stenosis of the tympanic orifice of the Eustachian tube with a resulting impaired ventilation of the middle ear followed by those pathological changes with which we are all so familiar.

The every-day treatment of exudative catarrh in young children is too often inefficient and insufficient. Though certainly we all attend to the gross and visible pathological lesions which are primarily responsible for its incidence we are prone either to forget or have not the opportunity of following up the case and assuring ourselves that the middle ears are really clear of all exudate.

The immediate benefit resulting for example from a properly performed operation for the removal of adenoids and the return of practically normal hearing within a few days either with or without Politzerization are results so remarkable that the tendency is to consider all is well; but is it so always? How many of our cases return in a few years with definite evidence of adhesive changes, and why? I believe the main reason is because we do not completely drain the middle ears of all secretion at the proper time. No doubt some here to-day will say—" totally unnecessary "—" it will be absorbed in time " —" by incising the membrane you risk converting a simple exudative catarrh into a purulent catarrh." I maintain that, if we are to take a long view, the indication to incise the membrana tympani and drain the middle ear is almost as necessary in exudative catarrh as it is in suppurative catarrh, the difference being that in suppurative catarrh it is imperative, in exudative catarrh it is a matter of individual opinion. I suggest that incision is necessary if we wish to be certain that the middle ear is clear of all secretion.

If we rely upon inflation we merely scatter the exudate for the time being—we blow it towards the posterior end of the middle-ear cleft into the tympanic antrum. Sooner or later it trickles down into the hypotympanum there to remain, there to act as an irritant responsible for the ultimate formation of that " ostial buttress " which is the dominant factor in the production of those pathological changes which ultimately induce distortion and disintegration of the middle ear. Follow the trend of pathological events and see what happens. Interference with the normal ventilation of the middle ear, either from the presence of a small amount of viscid exudate in the hypo-tympanum or from the presence of a definite although small amount of organized connective tissue around the tympanic orifice of the tube, is I believe the cause of the ultimate leucocytic activity in the subepithelial layers of the mucoperiosteum.

What happens? Lymphocytes and endothelial cells multiply rapidly with the result that dense sclerotic white fibrous tissue is formed either locally or diffusely in the middle ear, a tissue which gradually contracts and leads to rigidity or ankylosis of the ossicular chain, or to occlusion of the fossula rotunda with still further impairment of hearing. In the long run atrophic changes ensue with a gradual opening up of the Eustachian tube, but it is then too late, the damage is done, the middle ear has practically ceased to function. It is almost a paradox but much as we desire efficient ventilation of the middle ear the prognosis is better when the tube is partially obstructed than when it is too freely open.

To combat the progressive changes which are taking place we resort to pneumo-massage, injection *per tubam* of alkaline fluids, liquid vaseline, hot air, medicated vapours, the use of bougies and so forth, but do we do the patient any real good? I venture to say that intratympanic injections in cases of advanced sclerosis of the middle ear frequently do a great deal of harm. The obliteration or partial obliteration of the tympanic blood-vessels, the result of the fibroid changes going on in the subepithelial connective tissue, seriously impedes the absorption of the injected fluid and we return to the stage where we have an unabsorbed fluid, an irritant, lying in the middle ear and acting as a foreign body. If we desire to obtain benefit from intratympanic injections it should be in the nature of a lavage, a wash through—in other words we should provide a vent, we should incise the membrana tympani and wash out the middle ear with the aid of the catheter and air douche.

It must be within the knowledge of every one here that patients are frequently heard to say that after a course of intratympanic injections their hearing capacity has been made worse. I believe that they are often quite right, and that the means adopted to try to relieve them has had just the opposite effect.

Although I have little faith in intratympanic injections I hesitate to condemn them utterly, but what I do oppose is the method usually adopted—viz., the pumping of fluids into a cul-de-sac whose lining membrane has practically lost its powers of absorption.

We are dealing with much more than a catarrhal process, we are dealing with what may probably be shown one day to be a microbic disease affecting the deeper layers of the muco-periosteum—a condition somewhat akin to "keloid." What we are in the habit of calling a catarrhal disease is no longer a catarrhal disease but a diffuse fibrosis. To keep this tendency to fibrosis in subjection is the crux of the position and has so far baffled all attempts. It is our business however to survey the situation, to examine critically our present pathological standpoints to see if they fit in with our present knowledge, if some of them are not really relics of the past, relics which tradition and text-books have handed down and which we have blindly accepted.

In illustration, let me take the more or less prevalent conception that ankylosis of the ossicular chain—more especially synostosis of the stapedio-vestibular articulation—is a common sign of adhesive middle-ear catarrh. Clinical and pathological experience and observations made during operative interference compel me to think that it is not so common as is generally supposed. That it is fairly common I do not for a moment deny, but my conviction is that it is frequently absent even in very chronic cases.

In well advanced cases, where there is definite "paracusis Willisii," and when Gellé's test is negative, there can be no reasonable doubt of its presence, but what of those cases where there is no paracusis, where Gellé's test is, to say the least, not definite, and where there is severe deafness. What is the explanation? I believe myself that the tendency is to overestimate the importance of the stapedio-vestibular articulation from a pathological point of view and underestimate the importance of changes in the "membrana secundaria." Examine the topographical relations of the inner wall of the middle ear and see how easily even a limited fibrosis may block up the fossula rotunda and reduce the potentialities of the fenestra tympani. The deposition of new tissue in this situation forms a formidable barrier, a barrier which prevents excursion of the endolymph, a barrier which ultimately antagonizes the movements of the footplate of the stapes because of the well-known law of the incompressibility of fluids.

How often in past years, when operations for the relief of chronic catarrhal deafness were, I might almost say, the fashion, we have found the stapes freely mobile when we expected to find it ankylosed?

Again, the fact that the stapes is normally mobile, and unless ankylosed is still capable of responding to a certain intensity of sound wave, makes it all the more difficult for it to become readily fixed, for it is never completely at rest, whereas the membrana secundaria at an early stage becomes weighted by the deposition of new tissue and immobile. The function of the stapedio-vestibular articulation is thus put out of gear. Its movements fail to induce excursions of the perilymph because there is no corresponding yielding of the "membrana secundaria."

I regard the secondary membrane of Scarpa as of equal importance, from a pathological point of view, to the membranous attachment of the footplate of the stapes to the margins of the fenestra ovalis. Moreover, as the existing fibrosis starts from the region of the Eustachian orifice, it reaches the region of the fossula rotunda at a relatively earlier period of time than the region of the fenestra ovalis. Hence the many cases in which although there is well-marked middle-ear deafness there is no paracusis—in other words, the ossicular chain, although mobile, is unable to play its full physiological rôle.

If, then, we have, in a given case of chronic adhesive catarrh, a certain degree of Eustachian obstruction and a progressive damping down of the movements of the membrana secundaria, we have the two factors present which tend to prevent the normal transmission of sound waves and the normal excursions of the endolymph, both of which are necessary for the maintenance of good hearing.

The potential vacuum in the middle ear, created as the result of tubal obstruction, still further accentuates the difficulties, partly because it is more difficult for sound waves to cross the hollow space and partly because it tends to encourage exudation. This brings us to this position: Can we do anything to maintain an equable pressure upon the two sides of the membrana tympani during the time we direct our energies to relieve the existing tubal obstruction and endeavour to arrest the advancing sclerosis? If we inflate the middle ear we restore the balance temporarily, and—unless intratympanic fibroid changes are well advanced—generally with improvement in hearing, often evanescent it is true, but none the less real while it lasts.

I consider that we underestimate the advantages to be attained from artificial perforation of the membrana tympani. By this I do not mean the making of a clean incision which heals up in about twelve hours, but the making of a more durable perforation with a fine galvano-cautery point. It is, however, no use doing so if the patient has already lost more than 75 per cent. of normal hearing, as by this time sclerotic changes are so advanced as to preclude any hope of benefit following.

We all hesitate to puncture the membrane because the little operation has acquired an evil reputation, but my point is that even when it is done to-day it is generally done at a too late stage of the disease.

We have all noticed how well many patients with old perforations due to suppurative disease hear, and how if the perforation becomes cicatrized the hearing power is often made worse, how comparatively infrequent paracusis Willisii is in suppurative cases, and how an intercurrent attack of suppurative catarrh with perforation grafted on an adhesive catarrh so frequently also induces better hearing.

There is something in the mechanics of an open perforation the importance of which I do not think we realize sufficiently. Besides maintaining an equal pressure upon both sides of the membrana tympani does it exert any beneficial action upon the course of the disease? From clinical observations I believe that it does, and largely because it is the means of relieving tension, arresting exudation, and affording a direct channel through which medicaments may reach the inner wall of the middle ear. To maintain an open perforation is proverbially difficult. To do so we should imitate what Nature does in old suppurative cases—we should endeavour to epithelialize its edges by the implantation of epithelial cells, an extremely delicate and difficult piece of work, but possible of execution with care and patience.

Future progress in the treatment of chronic adhesive catarrh appears to lie not so much in the use of local applications—medicinal or mechanical—all of which have shown their comparative uselessness so far as the permanent improvement of the existing condition is concerned, but in the employment of radio-active substances whose rays have the power of softening and rendering pliable dense sclerotic tissue.

The β and γ rays of radium, or its emanation, if properly filtered, have the power, probably in virtue of their action upon connective tissue cells, of transforming hard and dense mesoblastic tissue into something approaching embyronic tissue, soft and pliable, and with the fibrils arranged in lines parallel to the superimposed skin or mucous membrane. Everything depends upon dosage, duration of exposure, and effective filtration, and it is to these problems I am devoting my thoughts, and would suggest that the members of the Section should do likewise, in the hope that some more satisfactory method of treating this very common, intractable, and disastrous disease of the middle ear may be discovered in the near future.

DISCUSSION.

The President said the subject of adhesive otitis, especially its treatment, was probably one of the most difficult in otology. It was important to make out what was the antecedent condition, and try to prevent it, and, having discovered it those in the specialty ought to be able to arrest its progress. With regard to the fluid content of the hypo-tympanum, when he was at the Children's Hospital in Great Ormond Street, he constantly had to incise the thick tympanic membranes of young children, and practically always fluid came out; it collected in the lowest part of the tympanum, and when that space was deep, below the level of the osseous meatus; the fluid there could not be seen. Sir William Milligan also said that this fluid gave place to connective tissue, which grew up towards the mouth of the Eustachian tube in front and blocked it. He (Sir Charles) did not remember seeing, at operations, the hypo-tympanum blocked up with scar tissue. Years ago, when he was aural surgeon to St. Thomas's Hospital, an operation he occasionally carried out was, in cases of adhesive otitis with serious deafness in which he thought the internal ear was little if at all involved, to take away the base of the stapes, or enlarge the fenestra rotunda. He did that with a very small trephine, and immediately put on an epithelial covering, so as to prevent the escape of perilymph. He had hoped in that way to get rid of the rigidity of the inner wall of the tympanum and so restore some of the patient's hearing. In only one case, however, did he think there was definitely improved hearing. He thought that in the future something of this sort would be devised, so as to get the patient to hear again through the strong bony boundary of the internal ear, even when the tympanum was still quite useless for functional purposes.

Mr. W. STUART-LOW did not agree with the views as stated in the paper. He believed that the mucous membrane lining the middle ear and the Eustachian tubes played a most important rôle in this affection, especially at the lower end of the Eustachian tubes—the lining there was normally thick and well supplied with mucous glands against the access of sepsis from the throat. In dry catarrh of the middle ear the mucous lining became thin and the glands few, so that, their important guarding function being impaired or lost, septic organisms could then readily advance upwards into the middle ear, where the membrane was in its normal condition very thin and glands but few, allowing organisms, once introduced, to have free play. For these reasons he would always employ warm applications of mucin to the pharyngeal end of the Eustachian tube, and as injections into the middle ear, alternated with warm mentholized oily preparations; in this manner adhesions were softened, desiccations obviated, and the thin lining nourished and thickened. He had frequently found after this treatment that middle-ear tinnitus abated and hearing improved. The tendency to thinning and drying of the mucous membrane in the throat and ear was doubtless hereditary, therefore, prevention should be carried out by placing the children of such patients in such favourable surroundings as to avoid the conditions which led to its development. The offspring of patients suffering from chronic middle-ear catarrh should, therefore, be encouraged to take up outdoor occupations instead of office and city work. He considered sepsis the primary cause of the insidious inflammatory change in the lining of the tympanum and Eustachian tubes, a change happening much more readily in persons possessing a thin, and, therefore, feebly resisting mucous lining. He had never seen any improvement in hearing nor the slightest abatement of tinnitus brought about by incising the tympanic membranes. That was only too likely to end in suppuration of the tympanum from sepsis introduced in the process. To be successful or ameliorative the treatment of chronic catarrh of the middle ear must be carried on assiduously and perseveringly over a long period.

Mr. RICHARD LAKE said the trouble was that there were no means of testing and subdividing the various conditions of the middle ear; the more one worked at tuning-fork tests the less one found them reliably applicable to these cases: there was no dependable base line. For the accurate subdivision such as he meant, men must work together quietly, and state the results to a meeting of the people practising the specialty, then probably advance would be made. If an ear condition was made worse by inflation, and another was improved by it, that indicated a definite difference in condition. Some heard better after ear injections, others were not improved by it.

Sir JAMES DUNDAS-GRANT hoped the picture was not usually as gloomy as Sir William had sketched it; he believed many of the cases which had been treated in the earlier stages did not pass through the insidious and harmful course indicated. Statistics on the matter were needed, and he would look up his own records. Hinton habitually perforated the membrane and washed through with a very weak solution of bicarbonate of soda, but gave it up as the results were not satisfactory. With our present methods of sterilizing the meatus one might dismiss the dangers of suppuration in cases which were hanging fire, for something vigorous must be done in order to get benefit. The problem associated with making a permanent perforation was not yet solved. Politzer introduced a little bead, but usually it worked its way down towards the margin and then was extruded. Parolein had been injected from the Eustachian tube through the perforation so as to keep it open, and some success had been claimed. Radio-active substances formed a two-edged weapon, and at least one case had been published in which the auditory nerve became paralysed six months after the use of a tube of radium inside the external meatus. Probably it was before radium was dosed and screened so accurately as now. A frequent cause of failure in these cases was a relaxed membrane with narrowing of the Eustachian tube. When this narrowing lasted a long time, the continuous slight in-drawing led to the membrane becoming thin and relaxed, and it was probably made worse by too-frequent inflatation of the tympanum. It was not as often detected and treated as it might be. He agreed that at the period when the tube was too freely open and the deafness considerable the condition was very difficult to deal with, and the prognosis quite bad.

Dr. W. HILL asked whether Sir William Milligan had looked up the literature with reference to the action of radium. He, the speaker, had made experiments with radium on the mucous membrane of the nose. It had no effect on, for instance, nasal polypus. The only effect was, that if used long enough it burned the membrane. He had never applied radium in the ear, except to see whether it had any effect on recurring granulations; for this he had put in small tubes containing minute quantities of radium; in one case he used Dr. Finzi's tube with 17 mg. of radium bromide, screened with one-third of a millimetre of platinum. Though applied on many occasions, this made no difference. He had looked upon the methods which relied on the action of radium in these conditions as more or less futile; they seemed bound to be futile until more was known as to the nature of the lesions being treated. Sir William, in using the term "exudation," referred at one time to fluid in the cavity of the tympanum, at another to exudation from the tissues. The function of the Eustachian tube was to drain off fluids which were secreted, but sometimes there was obstruction, inflation was done, and fluid came down. But he did not think it stopped there, as in the case of the nose in atrophic conditions. Atrophic rhinitis differed from atrophic median otitis, because in the latter crusts did not form. He did not think the retention of a little mucus in the lower part of the tympanum did much harm. If in the early stage the water-logged condition could be got rid of, there would be improvement—at least the condition would not progress. He would like to hear some brighter suggestions than going back to the practice of puncturing the tympanum, or even the use of radium, unless the whole question was reviewed in the light of recent knowledge—in the case of radium ascertaining what had been done at Middlesex Hospital. A few years ago the whole matter was most disappointing and discouraging. A study of results of action in the normal should be arrived at by experiments on animals.

Dr. ALBERT A. GRAY asked whether any members had seen adhesive processes in the middle ear apart from suppurative change. He had seen cases of so-called adhesive catarrh, and the little he was able to make out consisted of collections of dead epithelium, in one case the masses having the appearance of cholesteatoma. The mucous membrane might be thickened, and dead epithelial cells might form into a tough pasty crust. The atrophy of the membrane which Sir James Dundas-Grant spoke of he had himself seen; it usually was found at the posterior quadrant. The clamant need was for more post-mortem examinations on temporal bones. It was true that this meant time and trouble in preparation, but it ought to be done. He agreed with what Sir William said as to deposits in the floor of the tympanum. The most remarkable case he had seen was that of a woman whose tympanum and attic were filled with one tough mass of cholesteatoma, yet there was neither perforation nor suppuration. She was absolutely deaf, and she was 101 years old when she died. Post mortem, he found that the deposit of epithelial cells had eroded the two crura of the stapes, but left the footplate in place. He hoped to show the section.

Mr. SYDNEY SCOTT agreed that the matter called for research and new data. He considered Dr. Gray had hit the nail on the head. They wanted post-mortem findings in cases which had been tested during life in order to obtain correlated facts. Meanwhile other methods of research were helpful, and clinical observations sometimes threw light unexpectedly on obscure points. For instance, not long ago he saw at St. Bartholomew's Hospital a man aged 40, who was intensely deaf, and had signs of congenital syphilis, but he was quite intelligent. The right ear had been quite useless for many years, but the left, though deaf, had been useful until two weeks previously. The left drum-membrane was in the retracted position, and the left Eustachian tube was impervious to inflation, in spite of the introduction of gum-elastic bougies. After repeated efforts had failed to inflate the tympanum, the drum membrane was incised, a small straightened catheter was inserted through the incision into the tympanum and air blown into it. A thick mass of mucus was expelled, and on reintroducing a catheter through the nose, into the Eustachian tube, air was blown into the tympanum quite easily, and the patient's hearing improved to the extent that "he could hear a voice across the table," whereas he was unable to hear anyone's voice before. For two or three weeks the hearing fluctuated on the border line between "useful" and "useless." The mucus contained no spirochætes, but was full of organisms having the properties of *Staphylococcus aureus* and exhibiting hæmolytic action. The features of the case were the association of (1) Eustachian obstruction, (2) tympanic membrane in the retracted position, and the unexpected discovery in the tympanum of tenacious mucus, though by a somewhat unorthodox method.

Mr. HERBERT TILLEY thought those who had the duty of teaching the present day students in otological clinics should instruct them how to recognize mucus in the tympanum; its presence was often overlooked, even by those engaged in ear work. He had by him a preparation of very viscid mucus which he took from a tympanum years ago, and in spirit it looked liked the preserved lens from an eye. He often found patients giving a history of varying degrees of deafness caused by glutinous mucus which could only be evacuated by incising the tympanum. The best means he knew by which it could be diagnosed was, not by the line which was so often said to be seen on the tympanic membrane, but by passing a catheter and listening for the curious crackling sound on inflation of the tympanum, somewhat analogous to the moist sounds heard in cases with cavitation of the lung from tuberculous disease. After blowing out such material the relief was immediate and extraordinary. It might be necessary to open the drum two or three times in the course of a few weeks, until the catarrhal process ceased. The organization of this material might be one of the causes of the slowly-progressive cases of adhesive otitis. When the injection of fluids into the drum was introduced some years ago, he practised it in hospital and in private patients in scores of cases, using weak perchloride of mercury and alkaline solutions as well as oily preparations, &c., but he did not think he ever saw a case permanently benefited by it.

Sir WILLIAM MILLIGAN, replying on the discussion said: There were two conditions, a catarrhal disease, and a disease which involved the subcutaneous connective tissue. The term "adhesive catarrh" ought to be abolished altogether, as it did not express what was meant. There was need of a much more accurate classification of diseases of the middle ear; whether it was arrived at by otoscopic examination or by tuning-fork tests was another question. With regard to the President's remark as to scar tissue in the hypo-tympanum, Sir William thought he had mistaken the statement; he said exudate, not scar tissue. In his view, the scar tissue was mostly at the orifice of the Eustachian tube, what he had called the "ostial buttress." With reference to Sir James Dundas-Grant's statement that he, the speaker, took a too pessimistic view of the condition, that was not his usual attitude, he was generally inclined to be optimistic, but he asked members of the Section what did become of the cases under discussion; why were so many of them now being seen? His contention was, that it was because at the commencement of the process the otologist did not realize what was going on; the cases were not kept long enough under treatment, and the treatment was not sufficiently thorough. The instances given by Dr. Gray, Mr. Tilley and Mr. Scott he could repeat many times from his own practice. Very often the membrane was too opaque to be seen through. He was not afraid of the possible sepsis mentioned by Mr. Stuart-Low. He suggested that Dr. Hill's views on radium were distorted. This matter had been discussed many times, and he did not think a definite conclusion had yet been arrived at. But to put so many milligrammes of radium into the auditory meatus was asking for disaster. There was no question about the action of radium, when properly filtered, on the connective tissue cell. Sclerosis of tissue could be produced by it so that the tissue resembled a piece of boot-leather; surgeons often complained of this "leathery" condition after radiation. Properly used, radium had the power of softening sclerosed tissue and altering altogether distribution of the fibrils. An important histological point was, that the fibrils of the freshly formed tissue always ran parallel to the surface. His point was that by carefully regulated radiation, the sclerosed tissues were rendered supple and pliable. The results of local treatment were evanescent, and when organized tissue had once been laid down there was no effect from them. The word "catarrh" ought to be abolished in connexion with these cases; they should be called "fibrosis" of the middle ear. The profession had been working at this subject for twenty-five years, but was it in any better position to-day? His remarks on radium applied equally to X-rays if a Coolidge tube were used and every attention paid to screening and dosage.

Ear Syringe with Bayonet Joint and Curved Nozzle.

By MARK HOVELL, F.R.C.S.Ed.

THE bayonet joint was devised by the late Mr. Gardiner Brown, aural surgeon to the London Hospital, the curved nozzle by the exhibitor. The advantage of the bayonet joint is that the nozzle can be quickly taken off and put on for refilling. This is done easily on account of the larger orifice and the lessened resistance preventing air entering the syringe. The curved nozzle enables the stream of water to be sent against the walls of the meatus instead of on the more sensitive drumhead. By altering the position of the syringe, however, the bottom of the meatus can be easily reached.

Streptococcal Leptomeningitis in a Child due to Chronic Suppurative Otitis Media; Rapid Development of Coma; Radical Mastoid Operation with Translabyrinthine and Lumbar Thecal Drainage, with Complete Recovery.

By SYDNEY SCOTT, M.S.

THE patient, a girl, aged 10, was brought to St. Bartholomew's Hospital during Friday afternoon, July 23, 1920, in a state of unconsciousness with purulent discharge from the left ear.

History: The only history obtained before the operation was that the ear discharge had been noticed for "several months," but had caused no sign of ill-health until about a week before when earache was first complained of, and the child preferred to lie down all day instead of playing. During the week she felt ill and sick. Vomiting began on July 20, and on July 21 she had a "shivering fit" and pains in the head. On July 22 the vomiting and headache persisted, and she disliked being moved. (Some months afterwards, her mother recalled an occasion on this day, when on being moved the child called out "Hold me, quick, I'm falling downhill!") On July 23 there was an attack of "twitching of arms and face." A doctor was sent for in a hurry, and she was dispatched to the hospital in an unconscious state.

Condition on admission: The temperature was found to be 104° F., pulse-rate frequency 130, and respirations 30 per minute. The head was retracted and there was definite extensor-rigidity of the hamstrings. A reflex cry was provoked by attempting to flex the head forwards. The discharge from the left ear was purulent and fœtid. There was no swelling in the mastoid region and no sign of tenderness could be elicited. Both eyeballs exhibited marked rotatory nystagmus, the more rapid phase being when the upper meridians moved to the patient's right. Owing to the unconsciousness no further tests were applied, and the influence of ocular deviation was of course unobservable.

I considered it was sufficiently probable that otitis media had led to involvement of the labyrinth, and that this would account for a meningeal effusion; and though one could not be certain with such meagre evidence, owing to the gravity of the patient's general condition, I felt justified in operating immediately rather than incur the risk of delay.

Operation: The radical mastoid operation was therefore performed on the left side immediately. The mastoid antrum and cells contained pus, granulations and cholesteatomatous material. A carious patch of bone led back to a parasinous extradural abscess containing nearly a drachm of pus. The external semicircular canal was not eroded, and though no channel of infection to the labyrinth was identified, an opening into the vestibule was made below the facial nerve; the cochlea was extirpated in order to open up the fundus of the internal auditory meatus, and establish translabyrinthine drainage. The cerebro-spinal fluid then welled up freely for a moment, leaking away more slowly afterwards. The wound was packed open with dressings. The spinal theca yielded about 10 c.c. of turbid cerebro-spinal fluid on lumbar puncture. This was found to contain streptococci.

Lumbar puncture was repeated at intervals of twelve hours during the next few days, the fluid becoming gradually less and less turbid until the fourth day, when it was reported to be "straw coloured, clear and sterile." The day after the operation the temperature fell to 99° F., and did not rise again above 100° F. On the third day the flow of cerebro-spinal fluid from the labyrinth ceased. The notes say: "Consciousness returning, liquid food taken well." On the fifth day the child was beginning to "take interest in illustrated papers," and on the sixth day was "carried out of doors in her bed." From this time onwards her recovery was practically uninterrupted, though there was temporary facial paresis, which has disappeared, and slight jaundice, and for a few days she had a headache but no pyrexia. The nystagmus, which was unaltered by the operation, has gradually become less and less noticeable. The wound was closed, when I was away, during the fourth week, by my colleague, Mr. West, and the patient was discharged from hospital at the termination of six weeks.

DISCUSSION.

Mr. COLLEDGE referred to a patient, a boy, aged 13, who had the same symptoms as Mr. Scott's patient, and for which he (Mr. Colledge) performed the same operation. The cerebro-spinal fluid contained pus cells and streptococci. The ear was freely drained through the internal auditory meatus, and recovery ensued. It was the first time he did it, and he was so encouraged that he had done the same thing several times since, but had not again succeeded, though one case was temporarily improved. The temporal bone in this case was afterwards examined, and the internal auditory meatus was found to be blocked by blood-clot. In regard to the case which recovered streptococci were seen in the cerebro-spinal fluid, but they did not grow on culture. He asked whether those in Mr. Scott's case grew when cultivated. They might have been of low vitality, and that fact might have been a factor in the recovery, as well as the drainage.

Dr. DAN MCKENZIE referred to a case of septic meningitis he had shown some years ago in which drainage by Mr. Scott's method through the internal auditory meatus had proved successful. The patient was still alive and well. With regard to the translabyrinthine route for drainage it was suitable for cases with purulent labyrinthitis. In meningitis arising from other sources he had found that the basal cisternæ could be satisfactorily drained through an incision in the dura behind the petrous and medial to the lateral sinus. Through this opening a drainage tube with its inner end bevelled was passed in towards the cisterna magna. Free flow of cerebro-spinal fluid could thus be secured. The sloping end of the bevelled tube should be turned towards the petrous in order to prevent the blockage of the tube by brain-tissue.

The PRESIDENT thought this a magnificent case. Mr. Scott not only drained through the labyrinth, he also did lumbar puncture every twelve hours, a very important matter, and probably one of the reasons he did not have, for many days, drainage of cerebro-spinal fluid through his opening in the temporal bone. In such desperate cases he did not think it mattered whether the internal ear was destroyed or not: the patient was dying, and the surgeon had to try to save his life. If, as was proved in this case, the best way to do that was to go through the labyrinth, that was the right course. Some months ago he himself had a case of meningitis, and that patient was lumbar punctured twenty-nine times; he was very ill indeed, but he recovered. In some of these cases of meningitis, the Americans, instead of doing lumbar puncture, punctured the membrane between the atlas and the foramen magnum, in that way draining the great cistern under the cerebellum, or else opened the piamatral expansion over the back of the fourth ventricle. He was told it was easy to do, but one must not injure the medulla. It might come into practice here in time. Years ago, he drained cerebro-spinal fluid away in a case of internal hydrocephalus in a child by making an opening close to the foramen magnum, in the middle line, lifting up the cerebellum, and breaking through the piamatral roof of the fourth ventricle; this made an excellent drain. Another method of draining was along the posterior surface of the petrous bone. Drainage could not be secured in any region where there was cortex, as the cortex acted as a cork and sealed up the aperture. If one got the tube or gauze drain nearly as far as the cerebello-pontine angle, drainage could be secured, and could be continued at will.

Mr. SYDNEY SCOTT (in reply) said he should have mentioned that the organisms were examined morphologically and culturally, and proved to the satisfaction of the pathologists to have the biochemical characters of streptococci. He regarded the translabyrinthine route as restricted in its application to those cases of lepto-meningitis secondary to labyrinthitis. Its essential object was to drain the pia-arachnoid sheath of the seventh and eighth nerves in the internal auditory meatus. He did not expect the operation to prove as valuable when the basal meninges were infected by other pathways.[1]

Gunshot Wound of Temporal Bone.

By Sir CHARLES BALLANCE, K.C.M.G., M.S.

LIEUTENANT S., machine gun corps, A.I.F., joined up at age of 24.

December 24, 1916: Shell burst at Le Bizet. Right ear bled slightly.

January 21, 1917: Buried by shell burst, Hill 63. Concussion; unconscious four hours, right ear bled freely. Pain in right temple for some days.

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[1] Compare *Proc. Roy. Soc. Med.* (Otol. Sect.), 1917, x, p. 132.

June 7, 1917: Shrapnel wounds (at Messines) right mastoid region and over right upper jaw. Unconscious for some time. Operation at the casualty clearing station, Boilleau, on neck and jaw wounds; the neck, at this time, was much swollen.

September, 1917: Burning pains in right side of head and ear; vertigo;. foul discharge from right ear.

November 14, 1917: Radical mastoid operation. Discharge continued and various methods were employed for arresting it.

March, 1920: Seen by Sir J. Dundas-Grant and Sir C. Ballance. Burning pains on right side of head, often unbearable, and severe attacks of vertigo. Very low-spirited and depressed. Foul discharge. Operation by Sir C. Ballance: Extensive removal of carious bone; no labyrinthine fistula. Ten days later the cavity was covered by an epithelial graft; rapid healing.

October, 1920: Large retro-auricular opening closed. All symptoms have disappeared.

From June, 1917, to March, 1920, the patient lost weight (from 13 st. to 11 st.); he is now quite well. He has played county cricket all the past summer.

The bullets were probably removed at the operation at the casualty clearing station, but there is no record available. Tuning-fork heard on right side.

Gunshot Wound of Temporal Bone.

By Sir CHARLES BALLANCE, K.C.M.G., M.S., and Sir JAMES DUNDAS-GRANT, K.B.E., M.D.

CAPTAIN M., Royal Fusiliers, joined up at the age of 22. Gunshot wound near Cambrai, on December 2, 1917. The bullet entered the left temporal region, and the point of exit was behind the apex of the mastoid process. Considerable hæmorrhage occurred. The missile apparently crossed the tympanum on the inner part of the osseous meatus, damaging it and the cartilaginous meatus and the mastoid process. This was followed by profuse foul discharge, to effect a cure for which many plans were carried out.

March 10, 1920: Operation by Sir C. Ballance. (Patient was suffering at this time from foul discharge, much pain, vertigo, and mental depression.) The mastoid wound was widely opened. Much carious and necrotic bone was removed and infective granulation tissue also.

March 20, 1920: Epithelial grafting operation. Rapid healing resulted and all symptoms disappeared.

Patient has been playing first-class golf during last summer. The tuning fork is not heard on the injured side.

Radiogram of Cerebello-pontine Region in a Case of Suspected Auditory Nerve Tumour.

By Sir CHARLES BALLANCE, K.C.M.G., M.S.

Mr. S., AGED 50, a patient of Sir D. Ferrier. Partial deafness and tinnitus (left side) since April, 1916.

September, 1920, present condition: Sways in walking towards left. Sways to left when eyes are closed but does not fall. Stands with feet wide apart. Occasional feelings of nausea but no vomiting, and occasional pain left side of back of head. Has not been able to do business since April, 1916. No facial palsy; no inco-ordination of limbs; knee-jerks + +; no Achilles jerk; abdominal reflexes present. Eyes: Nystagmus on looking to left and upwards but not on looking to right and downwards; no optic neuritis; pupils small, normal reactions. In the street buildings appear to go up and down.

Many years ago had specific disease. He had long courses of treatment for this. Now Wassermann negative—blood and cerebro-spinal fluid.

Sir J. Dundas-Grant examined the patient. The reactions showed that the disease was not in the inner ear but beyond it.

The left cerebellar region was exposed, a large craniectomy opening being made. A radiogram was then made and apparently showed the presence of a tumour. On opening the dura no tumour was found, but there was evidence of old meningitis round the auditory nerve.

Hearing and Caloric Tests by Sir James Dundas-Grant.—When seen on October 18 the patient complained of high-pitched hissing tinnitus. The highest-pitched tones of Galton's whistle were heard with the *left* ear (therefore the lesion was more probably in the nerve than in the cochlea). The caloric (cold air) test on the *right* side produced nystagmus to the left in a little under 40 secs., also slight giddiness and past-pointing to the right; on the *left* side it produced *no* nystagmus after 80 secs. (indicating elimination of the left vestibular nerve). Hearing for the tuning fork c^1 (256 vibrations) on the *left* side by air-conduction was *nil;* by bone-conduction was minus several seconds (all pointing to a lesion involving the acoustic and vestibular nerve deeper than the cochlea).

Section of Otology.

President—Sir CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., M.S.

Cavernous Sinus Thrombosis: Notes of Four Cases.[1]

By T. RITCHIE RODGER, F.R.C.S.Ed. (Hull).

THE following are notes on four cases of cavernous sinus thrombosis, all of which occurred in one year (1919), and each of which illustrates a different mode of origin. In the first case I was able to demonstrate, by a somewhat heterodox line of treatment, which I would not seek to justify or repeat, that the superior petrosal sinus had been primarily infected from the middle or the inner ear without previous involvement of the sigmoid or lateral sinuses, and as far as I have been able to find in the literature of the subject, this has not previously been observed. The second case had a more common origin in a carbuncle on the nose. The third was of the more usual middle-ear type, in which the sigmoid sinus was first thrombosed and the process extended to the cavernous, presumably by either or both petrosals. The fourth was an example of infection following a frontal sinusitis, of which one case is included in the collected statistics of Dwight and Germain [1] and one has been reported by Dighton [2].

It is not necessary here to detail further the anatomy of the cavernous sinus, but there are two points I would emphasize: (1) The anastomosis is so free between the right and left sinuses by means of the circular sinus that thrombosis of both is probably the rule. In the cases of Dwight and Germain's series, where post-mortem results were obtainable, thrombosis on both sides was definitely stated in two-thirds. Of my cases I obtained consent for post-mortem examination in two only, Cases II and IV, and found both sides involved in Case II, while in Case IV the only demonstrable septic clot was on the distal side. In the other cases, where section was not allowed, the proptosis and chemosis involved both eyes, and almost synchronously. The importance of this is obvious. It is our greatest obstacle to successful direct attack on the sinus, and doubtless the explanation of most of our failures.

(2) The petrosals are not merely channels for emptying the cavernous sinuses into the sigmoid sinus and the jugular bulb, but receive blood also from small tributary veins in their course, helping to drain the triangular area of petrous bone bounded by them and by the sigmoid. The superior petrosal (I quote from Macewen) [3] receives blood from the inferior cerebral and superior cerebellar veins and small branches from the tympanum, many of which issue through the petro-squamosal sutures, the remainder passing through the bone directly into the sinus. The inferior petrosal receives blood from the inferior cerebellar veins, and from those of the aqueduct of the cochlea, the vestibule, and the fossa subarcuata.

The sigmoid sinus, because of its abutting directly on the mastoid cells, is the most common site of septic thrombosis, and it is undoubtedly true that most cases of cavernous sinus thrombosis of otitic origin are extensions from the sigmoid, but it is obvious that the petrosals may be directly involved by extension along the small veins referred to, and my first case is an illustration of this possibility.

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[1] At a meeting of the Section, held January 21, 1921.

Case I.—I. D., male, aged 12; first seen on December 13, 1918, suffering from sickness and giddiness of forty-eight hours' duration, vomiting irrespective of the taking of food. He was too giddy to stand, and always tended to fall forwards. There was a history of discharge from the left ear two months earlier, with recurrence from one week before admission. There was thick pus in the meatus, but the perforation could not be detected after mopping. Bone conduction greater than air conduction. Conversational voice seemed to be heard at 1 ft. There was marked spontaneous nystagmus to the left, ataxia was present, and swaying on doing the Romberg test. Kernig and Babinski tests negative; no headache; temperature normal; pulse 60. Cold caloric test to left ear did not reverse the nystagmus. Dr. Matheson Mackay reported both fundi normal. During twelve days stay in hospital pulse and temperature were normal, the nystagmus gradually disappeared, as also the giddiness and ataxia, so that after a week he was able to be up and about the ward. The discharge also gradually diminished, till at the end of a week the ear was practically dry. It seemed that the labyrinthitis had subsided, and when on December 24 he asked to go home for Christmas, he was allowed to do so, but told to return in five days. He was readmitted however on December 26 with partial facial paralysis on the same side (the left). He had vomited once since leaving hospital: neither nystagmus nor giddiness had recurred. The radical mastoid operation was performed at once, pus under pressure and granulations being found in the antrum. The dura of the middle fossa was exposed and appeared healthy. The dura of the posterior fossa was not exposed, as the symptoms did not suggest sinus thrombosis, and the sinus plate was healthy. On the bridge being removed there seemed to be granulations covering the adital portion of the facial canal and the wall of the external semicircular canal, but in neither situation could a definite gap be determined. During the whole subsequent course of the case nystagmus and giddiness remained absent, and the facial paralysis continued. Three days after operation the temperature rose to 104° F., with a rigor, and the same happened the following day, so that I exposed the sigmoid sinus, which, however, appeared healthy and was left untouched. Lumbar puncture yielded a clear cerebro-spinal fluid under normal pressure. During the next two days the same rise of temperature with rigors occurred, and I explored the sigmoid sinus with a syringe. Fluid blood was drawn off and retained for examination. The jugular vein was ligated. Next day there was no rise of temperature and no rigor, and the day after a slight temperature but neither rigor nor headache, but by this time the pathologist's report on the blood had arrived, and he had found pneumococci. I presumed then that there was a mural septic clot in the sigmoid sinus, not extensive enough to occlude the sinus completely, and that my needle had acquired some septic material when passing through this to the blood-stream beyond, and I proceeded to open and clear this out. The blood in the sinus was now of course thrombosed from ligation of the jugular a few days before, but the clot was clean, and no septic part adhering to the wall could be found. When this clean red clot had been scooped away, however, and the gush of blood from above had been established, just before we succeeded in stemming the latter, two small, worm-like pieces of soft blackish-grey clot were washed out, just of the calibre of the superior petrosal sinus. After this the temperature still continued to rise daily to 101° and 102° F., but without rigors. Then three days later—i.e., fourteen days after the radical mastoid operation, œdema of the face and both eyelids was noticeable. Gradually the eyes became more and more chemotic and proptosed, with limitation of the movements of the orbs. The septic thrombosis of the superior petrosal had extended to the cavernous sinus. Further operation was not suggested. Towards the end there was incontinence of urine and fæces, but none of the cardinal signs of meningitis ever appeared.

Post-mortem examination was not obtained.

Case II.—I. G., male, aged 31; admitted February 16, 1919, with a history of carbuncle on the right side of the nose a week earlier. There were marks of several small incisions on the right side and on the bridge of the nose. There was marked proptosis and chemosis of the left eye, and discoloration of the lids and of the forehead. The eyeball did not move and the sight was quite gone, even the light of a strong electric torch not being distinguished. Dr. Matheson Mackay reported the retinal veins very large and dark-coloured. The right eye showed neither chemosis nor limitation of movement and had good vision. Examination of nose and throat was negative. Ears normal. Temperature 101° F., pulse 78. Reflexes did not point to meningitis. Three hours later temperature reached 104° F. When seen again twelve hours after admission the forehead and the left eyelids were quite blue and the veins stood out prominently. There was some bulging and œdema of the right eye. Babinski's test gave extensor responses on both sides. Kernig's sign still negative. Death fifteen hours after admission.

Post mortem: The whole of the left cavernous sinus was full of septic clot; the communicating sinus exuded liquid pus; the anterior part of the right cavernous sinus contained septic clot and the posterior part uninfected clot. The sigmoid sinuses were normal. There was no pus in the orbital cavities. In death, the œdema of the face and eyelids, as well as the proptosis, had quite disappeared. In this last detail the case differed from one I saw in the wards of Dr. Maitland Ramsay [4] of Glasgow, ten years ago. This case was described by Ramsay in a lecture to the Ophthalmological Congress at Oxford in 1911, and details will be found in the *Glasgow Medical Journal* of that year. The picture presented was very similar to what I have just described, but Professor Teacher's post-mortem report shows proptosis persisting after death and the explanation is apparently to be found in the fact that he noted abscess in each orbit.

Case III.—G. B., male, aged 12; admitted August 6, 1919, with temperature 105° F. History of left otorrhœa of long duration. Distinct tenderness over left mastoid and down the neck. No signs of meningitis. Radical mastoid operation immediately performed. The sigmoid sinus was thrombosed and gangrenous in appearance. It was opened and evacuated and the jugular ligated. At the operation the question was raised as to whether there was not slight protrusion of the left eye. Two days later there was distinct bulging and chemosis of both eyes with a slight diminution of movement of the left; Dr. Mackay reported both fundi normal. I suggested operation on the cavernous sinus, but did not press much against the parents' objections in view of the fact that both sinuses were evidently involved. The symptoms became quickly more pronounced and death took place five days after admission.

Post-mortem not allowed.

Case IV.—C. V., male, aged 14; admitted September 10, 1919. Had been seen ten days earlier by Dr. Legge Roe at an Ophthalmic Dispensary with swelling over left eye, redness of conjunctiva and paresis of external rectus. Three days later there was distinct swelling of the right eyelid, and a tentative diagnosis of cavernous sinus thrombosis was made. Patient was advised to seek admission to the Infirmary. This advice was not followed till a week later when he was admitted under my care moribund. Temperature was 103° F., lips blue, face a dusky livid colour, slight swelling of left eyelids but no chemosis of either eye. An incision had been made over the left eye and a little pus came from it. Retraction of the neck was well marked; Kernig's sign well marked; Babinski's sign extensor. Examination of nose, throat and ears negative. A diagnosis of leptomeningitis was made and this was confirmed by drawing off turbid cerebro-spinal fluid. Patient died half-an-hour later.

Post mortem: A purulent exudate covered the whole of the left side of the brain and several ounces of pus drained into the basin. The lateral, sigmoid and longitudinal sinuses were normal, the left cavernous sinus showed no pus, but the circular sinus and the anterior part of the right cavernous sinus showed pus and soft thrombi. On stripping the dura from the roof of the left frontal sinus it was found to be adherent and the bone dark-coloured. This dark area of bone was removed and exposed the frontal sinus full of thick pus and gangrenous mucous membrane. The left ethmoid cells and left antrum of Highmore were in the same condition; the sphenoidal sinus, which was a single cavity with an incomplete septum in its posterior third, contained pus but the mucous membrane appeared healthy. The sinuses on the right side were normal.

When I examined this case I thought the previous diagnosis of cavernous sinus thrombosis was wrong, as the patient was obviously dying of a septic leptomeningitis, and the cardinal signs of the former condition had already disappeared, as they do in death if no orbital abscess is present to maintain the proptosis. The early diagnosis was however justified by the actual demonstration of the thrombosis post-mortem.

I do not wish to discuss the methods of direct attack on the infected cavernous sinus, having no new suggestions to make, but consideration of my first case raises questions of preventive and conservative treatment.

It is obvious that there is an essential difference in cases arising from infection in front as compared with those originating *a tergo*. The blood-current is from the ophthalmic vein and its anastomoses backwards to the cavernous sinus, thence by the superior and inferior petrosals to the sigmoid and the jugular bulb. A septic clot forming in one of the small tributary veins in the region of the orbit or the nose, may be transplanted thence to the cavernous sinus and in the slower current of the latter may set up septic thrombosis with rapid onset of symptoms. In middle-ear cases, however, the septic extension is against the direction of the blood-stream, and must necessarily occur forwards along a preformed aseptic clot. In other words, when cavernous sinus thrombosis occurs in connexion with septic clotting in the sigmoid or petrosal sinuses, the cavernous sinus condition is at first, and for some time, one of venous stasis from damming back of its blood-current by a septic clot situated in either of these other sinuses, and the cardinal signs, startling and outstanding as they always are, may be merely signs of blocking, not of sepsis, in the cavernous sinus. If this be so, is it not reasonable to suppose that some cases might be saved, and is it not probable that some of the cases of spontaneous recovery, that is recovery without direct attack, should be so explained?

Spontaneous recovery occurred in fourteen of Dwight and Germain's 182 collected cases. J. S. Fraser [5] and Dan McKenzie [6] have each reported cases, and in the *Journal of Laryngology* of October, 1919, a review appeared of a case reported by Torrini [7]. Dighton [8] was doubtless right in attributing the recovery of his otitic case to the suction action of lavage of the jugular bulb, the septic block being aspirated from the inferior petrosal. The elaborate arrangements made by Nature to safeguard the sinuses from interference by the respiratory movements as outlined by Macewen [9] in his chapter on the "Dynamics of the Sinuses," no doubt reduces the force of such aspiration, but it is probably quite efficient.

Similar lavage of the posterior end of the superior petrosal is not, of course, feasible, but I have demonstrated how it was effected, in Case I, by the blood-current from the lateral sinus. If we have reason to think there is septic blocking of the superior petrosal, say in a case with sigmoid sinus thrombosis and early cavernous sinus symptoms, where on clearing out the sigmoid, bleeding from below demonstrates a patent inferior petrosal, would it be possible to attempt to apply suction to the superior petrosal by removing the upper sigmoid plug daily for a few seconds, instead of leaving it in position for four or five days till clotting has occurred behind it?

In conclusion, I would submit that although thrombosis of the cavernous sinus is one of the most fatal conditions met with, a sufficient number of recoveries have been recorded without direct attack, to encourage us to use every available measure to attain that end. When dealing with a sigmoid sinus thrombosis the most scrupulous cleansing of the mastoid cavity must be secured before opening the vein, and the greatest care observed in inserting the upper plug, so that the clot forming behind this shall remain aseptic. Every possible aid should be supplied to the patient's natural resistance—sera or vaccines, and suitable feeding. Equally important is fresh air. The physicians claim in recent years to have reduced the death-rate in pneumonia and bronchopneumonia by treating their cases on the balcony ; the general surgeons report similar results from the similar treatment of prolonged suppuration in bones. Should we not get better results in all forms of intracranial suppuration if we could adopt this simple procedure? In many of our unsuccessful cases of intracranial complications after drainage of cerebral or cerebellar abscess, or of the meninges, or of a sinus thrombosis, the fight is so prolonged as to give one the impression that some little advantage at some point or other of the course might have tipped the balance on the side of success. Is it not possible that treatment in the open-air might provide that advantage?

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Tympanic Exostoses.

By W. M. MOLLISON, M.Ch.

THE patient, a girl aged 20, attended the hospital for nasal catarrh and sore throat. She was found to have adenoids. Some years before she suffered from otorrhœa, but that had ceased. Examination of the ears showed exostoses ; on the left side there is one springing from the anterior section of the tympanic ring. On the right side is a small one springing from the upper and anterior part of the tympanic ring, and reaching back so as almost to touch the short process of the malleus. There is a second very small one actually in the membrane just below the tip of the malleus handle, and a third in the posterior part of the membrane.

Meatal Polypus due to Sinus of the Superficial Bony Meatal Wall.

By W. M. MOLLISON, M.Ch.

THE patient, a girl aged 18, has suffered from chronic middle-ear suppuration for some years. During that time she has had exacerbation of pain and discharge, accompanied by hæmorrhage. There is a small polypus on the posterior meatal wall, quite near the conchomeatal junction. At the attachment of the polypus is a sinus leading backwards into the mastoid process.

Tinnitus associated with a Rhinolith of Unusual Size.

By LIONEL COLLEDGE, F.R.C.S.

THE patient, a woman aged 59, complained of tinnitus in the right ear. She had suffered from this many years. She complained also of some discharge from the right nostril and obstruction. These symptoms had been worse during the last two years, but the chief trouble was the tinnitus. There had been very little pain in the nose and no deafness.

On examination the right ear was found normal. Examination of the nose showed the usual signs of suppuration in the right antrum and some small mucous polypi. With a probe the stone could be felt giving a characteristic sensation to touch.

A radical Caldwell-Luc operation was performed in the right antrum and the stone exhibited was removed with forceps from the nasal fossa. It had enlarged the nasal fossa and had to be partially crushed in order to extract it without damaging the nose. A carious second bicuspid tooth was also extracted. Since then the symptoms have been greatly relieved.

Pyorrhœa Alveolaris affecting the Ears.

By ARTHUR J. HUTCHISON, M.B.

Case I.—Miss M., aged 18. Increasing deafness and tinnitus in both ears. Membranes normal in appearance. Watch heard at 20 in. in right ear, and at 6 ft. in left. Whisper at about 6 ft. in each ear. Rinne positive for all forks; bone conduction short. Tinnitus becoming steadily worse, keeping her awake. Pyorrhœa alveolaris discovered, five teeth extracted, thereafter improvement. Tinnitus ceased altogether, and hearing improved to watch 12 ft. in right and 9 ft. in left ear. Whisper about 20 ft. No other treatment. Remains well.

Case II.—Mr. H. F. S. had pain off and on in right ear from August to October, 1919, probably started by bathing. From October, 1919, to November, 1920, discharge from right ear, varying from profuse to almost none at all. Treated in London, and by myself with various remedies, including antiseptic drops, syringing, packing, vaccines, ionization. In the spring of 1920 began to have pain in right elbow, later in knee and in neck. In October, 1920, pyorrhœa discovered; teeth extracted; within a couple of weeks ear became perfectly dry, discomfort in it ceased, hearing improved, pains in joints disappeared. Remains well.

Gunshot Wound of the Ear: Retention of Bullet for Fifteen Months.

By Harold A. Kisch, F.R.C.S.

Private J. was admitted to a Military Hospital in London, in January, 1916, suffering from extreme rheumatoid arthritis. He was much emaciated. Practically all joints were affected, so that he was unable to walk or feed himself. He was morose and would give little information about himself.

On examination there was a profuse offensive discharge from the left ear, and the middle ear was filled with granulations. There was some tenderness over the mastoid, and a tendency to spontaneous nystagmus in both directions. Bone conduction was apparently present on the left side, but little value could be placed on tests owing to his mental condition.

After some hesitation he consented to operation. On the middle ear being exposed the base of a bullet could be seen just below the promontory. With some difficulty a complete rifle bullet was extracted, the point of which must have been in close relation with the carotid artery. No sign of fracture of the external auditory meatus was seen.

Next morning the sister showed him the bullet and he immediately said: "There, I always told them it was there, but no one would believe me." He was very pleased, and his mentality immediately changed for the better. He told us that he was in a wood near Ypres, in October, 1914, when he felt a "clack" in his ear. He fell down for a moment and then went back with his comrades. As there was some bleeding from the ear he was sent to Rouen, where he was X-rayed, but nothing was seen. His ear started to discharge and his joints commenced to be affected. He was sent home, and transferred from hospital to hospital, until he was eventually pensioned.

He made an uninterrupted recovery as regards the ear. His joints also improved, so that he is able to live an ordinary life.

The points of interest are: (1) the length of time, fifteen months, the bullet was retained in the ear; (2) the absence of fracture of the meatus; (3) the rapid occurrence of rheumatoid arthritis and its disappearance on removal of the septic focus.

Foreign Body in Mastoid Antrum.

By T. JEFFERSON FAULDER, F.R.C.S.

BOY, aged 8, was admitted on July 7, 1920, suffering from a foreign body in the left ear. A blue bead was visible in the deeper part of the meatus beyond the isthmus, completely filling the lumen and surrounded by a small rim of wax. No history was obtained. In the post-aural groove on the same side there was a healed scar, not of recent date, concerning which also no history was obtained, the boy having come from overseas.

July 8, 1920: Attempts were made to extract the bead (*a*) *per vias naturales*—this failed; (*b*) post-aural incision in the line of the old scar was made, the auricle turned forwards and the meatus incised. The foreign body was found to have disappeared, and was not either in the meatus or the tympanum. No normal structures could be made out in the tympanum.

July 10, 1920: Post-aural wound was reopened. A depression was found on the surface of the mastoid process, rather below the level of the spine. This was deepened and widened until the antrum was opened exposing the bead lying amongst granulations. The bead was removed and the radical mastoid operation completed. It appeared to have arrived there by way of a much enlarged aditus.

Section of Otology.

President—Sir CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., M.S.

Zinc Ionization and Electrolysis in the Treatment of Chronic Otorrhœa.[1]

By A. R. FRIEL, M.D.

BEFORE coming to a conclusion on the value of zinc ionization in the treatment of chronic suppurative otitis media one would like to know the reason why it should be useful; the particular condition to which it is applicable; and then to see a record of *all* the cases of a series in which it was the sole or almost the sole treatment.

The cases here recorded were treated at the Royal Free Hospital; the Aural Clinic for Pensioners at Park Crescent; and at an L.C.C. Clinic in Stepney for the treatment of otorrhœa in school children by ionization, and I wish to acknowledge the facilities which Mr. Gay French of the Royal Free Hospital and Sir James Dundas-Grant of the Aural Clinic have generously afforded me.

When a patient gets an attack of acute otitis media his *tissues* are attacked by a germ of one species—e.g., pneumococcus or streptococcus. Often if insufficient care is taken, the *discharge* becomes infected with other varieties of germs from the skin. This is the usual cause of the commencement of chronicity. The "confection" (to borrow an expressive term) of broken down serum and leucocytes of bacteria and their products *irritates* the tissues with which it is in contact and they respond by secreting pus. This is the condition which will be referred to afterwards as "tympanic sepsis." Other conditions may be superadded later on, such as polypi or caries.

For tympanic sepsis zinc ionization is, I submit, a correct and effective treatment.

By what is called "drainage" we deal with the macroscopic accumulation of considerable quantities of discharge, but we do not deal with the microscopic layer of serum and bacteria adhering to the tissues. By ionization we can permeate this layer—penetrate it completely with zinc ions and render it sterile.

We may classify cases of chronic otorrhœa into those which show:—

(1) Tympanic sepsis alone.

(2) Tympanic sepsis plus attic or mastoid sepsis.

(3) Tympanic sepsis plus inflammation of the external auditory canal, or of the Eustachian tube with or without septic teeth, inflamed tonsils or adenoids or infection of the nasal sinuses.

(4) Tympanic sepsis plus polypi, or granulations, or areas of caries.

(5) Tympanic sepsis plus combinations of two or more of the above mentioned conditions.

The cases for which treatment by ionization alone is sufficient are cases of tympanic sepsis pure and simple, in which the perforation in the drum is large enough to allow of the introduction of the zinc solution and of the distribution of the electric current in sufficient amount.

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[1] At a meeting of the Section, held February 18, 1921.

Cases under the third heading require additional treatment to guard against the possibility of relapse.

Cases in which polypi or granulations are present are frequently quite amenable to zinc ionization after the polypi and granulations have been dealt with.

Cases in which there is attic or mastoid suppuration are nearly always unsuitable for treatment by ionization alone, because it is not usually possible for the fluid to gain access to the whole of the infected area.

The technique of ionizing the middle ear is simple. The ear is first cleansed and then syringed with the warm zinc solution: zinc sulphate, 75 gr.; glycerine, 2 oz.; aq. ad 70 oz. The patient is now lying on the sound side, and the ear-piece of a Siegle's speculum is inserted into the meatus, some of the zinc solution poured in and gentle aspiration practised so as to remove any bubbles of air which may be in the tympanum. The positive electrode, which consists of a piece of zinc wire inside a vulcanite speculum, is then placed in the ear and the negative electrode on the arm or leg. The current is turned on and gradually increased to 2 or 3 ma. and allowed to flow for ten minutes and then gradually decreased. The ear is not dried. If it had been observed at the time that the mucous membrane was much swollen, or that some small granulations were present, or it is known that the patient does heavy manual work which might favour slight exudation, boric acid is insufflated. It is usually impossible to blow the powder into the middle ear, but it remains for a time in the meatus.

The patients here recorded were not selected except that only those were ionized in whom the otorrhœa might be provisionally considered to be owing its chronicity to tympanic sepsis alone. They were instructed not to use any treatment at home, and to be careful not to allow any water to enter the ear. They were not seen again after treatment for some days.

Previous experience has shown me that the cessation of suppuration often takes place immediately, and that within twenty-four hours the ear is dry and free from signs of inflammation. It is this rapid and complete subsidence of suppuration that serves as a criterion in assessing the value of zinc ionization in treating local sepsis.

Ionization is an aid in diagnosis as well as in treatment. If there is failure in what seemed to be a suitable case the cause of the persistence of the discharge may be quite evident after one ionization. The greater part of the ear may appear healthy, but by contrast with healthy tissue a granulation or a small polypus may now be distinctly seen, pus may be visible at the aditus region or be aspirated from some recess, or a small perforation may be detected in Shrapnell's membrane.

Cases which owe their chronicity to tympanic sepsis plus polypi or granulations can be treated by dealing first with the polypi and granulations, and later on by treating the tympanic sepsis with zinc ionization.

Small polypi and granulations can be most effectually treated by zinc electrolysis. In the case of large polypi as much as possible may first be removed by a snare, and then the stalk treated by zinc electrolysis. Zinc electrolysis is superior to caustics, as it does not cause inflammatory reaction: its application can be limited to the exact part which it is desired to treat, and the effect, although localized, is much more intense than when caustics are applied to the surface. Two needles, of which the positive one must be coated with zinc, are inserted into the polypus as near its attachment as possible, and the stalk or base coagulated. The rapid disappearance of the polypus or granulation without inflammatory reaction is remarkable. The object of using two needles is to avoid vertigo when the current is turned on. A strength of from 1 to 4 ma. for two to ten minutes can be easily tolerated. The previous application of cocaine renders it a simple and nearly painless procedure (*vide* Cases 53, 54, 67, 74, 91, 100).

Attention may be drawn to a patient (Case 64) who had a fœtid discharge from a large perforation in the attic and from a large perforation also in the posterior part of the membrana tensa. These were separated by tissue extending from the short process and upper part of the handle of the malleus to the posterior angle of the notch of Rivini and adjacent part of the bony wall. After consultation with Mr. French this tissue was destroyed by electrolysis, and the two perforations joined into one. The exposed parts were carefully cleansed by ether, &c., and the ear ionized with success.

I have thus sought to demonstrate the basis arrived at from experiments in the laboratory on which ionization as a method of treatment is established; then to state the factor which is amenable to treatment by zinc ionization; and after that to give an account of the technique adopted and the results obtained.

The treatment of the cases of otorrhœa by zinc ionization is a *concrete* example of the benefit to be obtained in local sepsis from applying the discoveries and teachings of Professor Leduc of Nantes.

[Lantern slides of diagrams and experiments explaining the theory and practice of ionization were shown on the screen. The paper was accompanied by typewritten accounts of the successful cases, giving in detail the whole treatment adopted in each case; and of a selection of the unsuccessful cases with the ascertained reason for non-cessation of the discharge (polypus, mastoid disease, &c).

A copy of these case records is available in the Society's Library.

Addendum.—The following letter has been addressed to the author by Mr. Gay French, F.R.C.S.: "I am sending a list of the cases I have so far treated with zinc ionization: Total number of cases treated, sixty-three; total number of cases with complete cessation of discharge after one treatment, eighteen; six of these have been treated over a year ago. Twenty-four cases required two to six treatments: most of these were old-standing cases with granulations. The granulations were first treated with 50 per cent. trichloracetic acid, and then with ionization. There has been no recurrence in any one of these cases. Twenty-one cases proved failures: of these eight are definitely better but the ear still remains moist; six were subsequently operated on—two of these were found to have cholesteatoma; four had old standing involvement of the mastoid. I can only say that, personally, I consider this method of treatment for tympanic suppuration is far better than any other. I also consider it useful from the diagnostic point of view, inasmuch as failure generally denotes some involvement of the mastoid."

DISCUSSION.

Sir JAMES DUNDAS-GRANT offered his personal testimony in support of what Dr. Friel had advanced, having had his assistance in a Pensions Aural Clinic, where he treated a number of obstinate cases. Some of these cases yielded to ionization after having resisted other methods; in fact some of the results were astounding. Dr. Salisbury Sharpe had also brought forward some most successful cases treated in the same way but in one the appearance of the membrane was hidden by the crusts in the meatus. The results seemed to be at their best where there was a large central—not marginal—perforation, and particularly when it was not in that danger-spot, the postero-superior quadrant.

Dr. W. SALISBURY SHARPE (introduced by Dr. Andrew Wylie) said that some cases had been shown illustrating the successful treatment of this disease by ionization. Notes had also been shown of cases "not improved" or in which the condition had recurred. From this demonstration the conditions favourable or unfavourable to the success of such treatment were seen to be as follows:—

(*a*) *Favourable.*—A large perforation giving free drainage and free access to the whole tympanic cavity. Absence of granulations or other evidence of actual bone disease.

(*b*) *Unfavourable.*—Small perforation giving poor drainage and incomplete access to interior. Granulations or other evidence of bone disease.

Duration of discharge did not appear to be a great factor, though, other things being equal, a more recent case should clear up sooner than a long-standing one provided that the acute stage was over. In other words the cases which did best under ionization were those in which the outlook was most favourable under other modes of treatment; but the results shown were evidence that ionization would at all events sometimes cause a rapid and striking improvement in a case which had otherwise been at a standstill. In these cases the effect of greater attention to cleanliness, &c., had been eliminated by entirely ceasing the use of drops or other local measures after ionization. When ionization had been done, the ear was let alone entirely till it had been seen again (say ten days later), so that any effect observed might be indubitably the effect of the ionization.

[In order to illustrate favourable and unfavourable cases, seven cases were shown by Dr. Salisbury Sharpe in which complete cessation of discharge had resulted from the treatment and had not recurred. Notes were read of one case which at first had some benefit, but in which recurrence occurred twelve months later, and of two cases in which no improvement had been effected.]

Mr. STUART-LOW said that soon after this method had first been published in the *Lancet* some time ago he employed it in a number of cases, but with such disappointing results that he ultimately gave it up as a failure. The majority of the cases in which he had used it were those in which the attic was involved and granulations present, in which the light application of the galvano-cautery point generally acted very satisfactorily. The good results as described by Dr. Friel in the report of his cases were largely due to not syringing, and, therefore, practically using the dry and open-air method of treatment which he himself had found so very successful.

Mr. NORMAN PATTERSON asked whether the method had been tried in the cases in which a radical mastoid operation had been done, and the discharge continued in spite of all the surgeon's efforts to dry it up.

Dr. ANDREW WYLIE said he examined Dr. Sharpe's cases before treatment and was astonished at the results. Two cases shown to-day were mastoid operations performed by him in which the ear still discharged. After one application by Dr. Sharpe the mastoid cavity was quite dry. Of course they must wait twelve months and see the ultimate result before stating that this treatment was a cure.

Dr. P. WATSON-WILLIAMS said that in the few cases in which he tried this treatment he was disappointed, possibly because there were complications which militated against success in the way described in the paper, or there might have been some fault in his own technique. In the light of this paper he would give the method a further trial. He asked how the method could bring about a good result in cases of persistent suppuration following mastoid operation, in which the trouble was due to old-standing infection of the upper end of the Eustachian tube. His practice had often been, in these cases, to re-curette the Eustachian tube. Also, how could one ensure that proper electrical contact would occur in this part of the Eustachian tube?

Mr. LAWSON WHALE asked why Dr. Friel differentiated the cases into categories, according to the stage reached by the suppuration, seeing that the success of the method depended on the coagulation of the microbes and thus upon their death. Why should not the method be applicable also to acute cases, so long as the membrane showed a perforation sufficiently large to enable an electrode to be passed?

Mr. SYDNEY SCOTT asked whether Dr. Friel had checked his results by bacteriological examinations beforehand.

Dr. FRIEL (in reply) said the cases now described were not bacteriologically examined before treatment. The method was not intended for the remedy of any factor except sepsis, which was accessible to the zinc solution. In acute otitis media at the stage when there was *profuse* discharge it would be difficult to keep the zinc solution in contact with the tissues. At a later stage, when the discharge had become less, zinc ionization was successful (*see* Case 46).

Paralysis of Eye Muscles occurring in connexion with Mastoiditis; Recovery.

By W. M. MOLLISON, M.Ch.

IN the two cases to be described, paralysis of the eye muscles came on in the course of mastoiditis; in the first case, after operation for acute symptoms arising in the course of chronic suppuration; in the second, in the course of simple acute mastoiditis. In the latter case there was no rise of pressure in the cerebro-spinal fluid as evidenced by lumbar puncture. In the first case the cerebro-spinal fluid was under increased pressure and was slightly cloudy. In both cases recovery was eventually complete. In neither case was any extension of disease found towards the tip of the petrous bone though it was sought for. In both cases the symptoms were suggestive of meningitis, and it would seem on the evidence available, that the eye paralyses were more probably due to metastatic infection than due to direct spread of infection to the tip of the petrous bone and so to the nerves as they cross to the outer wall of the cavernous sinus. If the infection was metastatic, it must almost certainly be a meningeal infection of the nerves and not a nuclear or central infection.

CASE I.

Boy, aged 12, was seen on December 27, 1915. Six years previously he had had scarlet fever and since then had suffered from right-sided otorrhœa. On December 7 he complained of pain in the right side of the neck and back of the neck; temperature 104° F., slight otorrhœa; on December 10, Mr. Holman saw the boy, who then was complaining of pain in the temporal region; temperature 102° F., and there was some tenderness over the apex of the mastoid and very slight tenderness over Macewen's triangle.

On December 11 the boy was somewhat drowsy, complained of pain in the right orbital region: temperature 100·2° F., and rather more otorrhœa. December 12: Condition unchanged and operation performed.

Hard mastoid. Pus found in the antrum; radical mastoid operation completed but no further complication found. Wound sewn up and cavity packed with gauze after application of B.I.P.P. The following day there was some œdema of the side of the face and eyelids, some difficulty in opening the eye. For the next three days fairly satisfactory, the œdema disappeared; the patient ate well and had no vomiting; the temperature, however, was raised in the evenings to between 100° and 100·2° F., though normal in the mornings, and now and then he was rather drowsy.

December 17: Complained of pain in the back of the neck on raising his head: this may have been due to some infection of the soft tissues behind the mastoid and on December 19 a second operation was performed; a few minute points of pus in the bone were opened, no pus was found in the tissues behind the mastoid. The condition did not alter materially till December 27 when the boy vomited in the early morning and complained of headache. The temperature had been normal or subnormal after the second operation but now rose to 102° F. Examination showed no nystagmus; no dysdiadokokinesis; no optic neuritis, but in view of the symptoms and some tenderness round the wound, operation was decided upon. Lumbar puncture showed the cerebro-spinal fluid under increased pressure and slightly cloudy. The wound was re-opened and small septic granulations found in the bone at the top of the mastoid and towards the middle fossa; the dura mater was widely exposed and a small rough area found over the tegmen tympani (previously exposed at the first operation); after painting the dura with pure carbolic acid the brain was explored with negative result. The lateral sinus and dura of the posterior fossa were normal. Wound left open. The following day lumbar puncture showed clear fluid but under increased pressure; the next day the fluid was clear and under normal pressure. The patient's condition was worse, headache, nausea, no appetite, and pulse fell to 56 and 50. On the third day after the operation there was found in the wound at least a drachm of pus (not previously or subsequently found) and what appeared to be a very small sinus in the dura of the posterior fossa; pressure on the dura did not produce any more pus but caused pain above the right eye.

December 31: Four days after operation the boy was much better but the vision of the right eye was hazy; there was ptosis of the eyelid and dilated pupil. The next day, in addition, external strabismus was present.

From then onwards the boy made an uninterrupted recovery though the third nerve paralysis took five or six weeks to disappear. Seen a year later the boy was perfectly well.

The needle used for exploring the brain was not introduced more than 1 in.

CASE II.

Boy, aged 10. This was a case of acute mastoiditis with few symptoms. The boy was seen on May 31, 1920; eight weeks previously he had had chicken-pox; with it some pain in the right ear, but this lasted only a short time. About three weeks later he again had pain in the right ear and slight discharge, which had continued but was very slight in amount; his temperature had been 103° F. but had dropped; he had not complained of any pain for the last three weeks. He has become much thinner the last two to three weeks. For the last ten days he has had daily vomiting of the cerebral type; his pulse-rate was 60 but has dropped to 56, 54 and 42.

Notes on examination on May 31: The boy is very thin and pale, mentally alert, complains of no pain except above right eye. Temperature 99·5° F.; tongue moist. Ptosis of right upper lid, paresis of right external rectus and perhaps of the internal rectus; no nystagmus; pupils equal; no optic neuritis. Knee-jerks equal; superficial abdominal reflexes normal. There is a little pus in the right meatus, deeply situated, which returned after wiping, odourless; granulation on the membrane. No tenderness over the mastoid process (the boy is one who will not admit to pain) and no thickening at the tip.

A diagnosis of acute mastoiditis was made with alternative possibility of a cerebral abscess or tuberculous meningitis.

Operation on the mastoid showed extensive suppuration; wide exposure of the dura mater of the middle fossa and posterior fossa showed dura normal. Lumbar puncture showed cerebro-spinal fluid of normal appearance and under normal pressure.

Some improvement followed operation; vomiting lessened and pulse rose to between 60 and 80 but after about a week symptoms were again marked.

On June 12 the wound was again opened; no further suppuration was found; the dura mater was exposed as far towards the tip of the petrous bone as was possible, but nothing abnormal was found. The temporo-sphenoidal lobe was explored but no pus was found. After this operation the boy quickly improved; the vomiting gradually ceased; the paralysis of the eye muscles had all disappeared at the end of six weeks.

Both cases had certain features in common ; pain about the affected eye, nausea (or vomiting), slow pulse, combined with paralysis of the levator palpebræ superioris ; but in the first case paralysis of the third cranial nerve, in the second of the sixth cranial was present. It is probable that some form of meningitis was responsible for involvement of individual cranial nerves, though the evidence is very poor in the second case.

Middle-ear Suppuration with Paralysis of the External Rectus Muscle of the same Side.

By Arthur J. Hutchison, M.B.

A boy at school, aged 7, sickened with measles on June 5, 1918. Defervescence was not satisfactory. On June 11 he complained of pain in the right ear ; this passed off during the following night. Next day he complained of pain in the left ear and over the left eye, and temperature rose to 101° F. After paracentesis of the left tympanic membrane the pain ceased and temperature dropped to normal.

On June 17, there was a sudden rise of temperature to 102° F. in the morning, accompanied by shivering, but by the afternoon temperature was normal and the boy appeared well.

About the beginning of July the left ear began to discharge freely and pain was complained of.

On July 4 a squint developed, due to paralysis of the left external rectus. I operated on the mastoid, finding only red inflamed bone but no pus, except in the antrum and attic, and after removing the antro-attic roof found apparently normal dura mater.

Five days later temperature ran up to 103·8° F., pulse to 148 ; the boy vomited three times and slight stiffness of the neck was detected. Lumbar puncture gave turbid fluid, under considerable pressure, from which streptococci were cultured. Lumbar puncture was repeated daily. The fluid became more and more turbid. Antistreptococcus serum was injected daily, both into the flank and into the canal.

Death on July 16. No post-mortem.

[A synopsis of the literature of this subject is given in an article by Mr. Douglas Guthrie in the *Edinburgh Medical Journal*, July, 1917 (Abstract, *Journal of Laryngology*, July, 1918, p. 220).]

DISCUSSION.

Mr. HUNTER TOD said that these cases were of great interest as the cause of paralysis of the external rectus in middle-ear suppuration was not fully known, and therefore it was difficult to determine the correct line of treatment, especially as to whether the dura mater should be incised or no. His experience was that such paralysis following the mastoid trouble was rare. He remembered one or two cases all of which completely recovered. His first case, nearly twenty years ago, was that of a porter at the London Hospital who had sixth nerve paralysis following middle-ear suppuration. Abscess of the brain was diagnosed and an exploratory operation advocated by the medical and surgical nerve specialists. As there were no intracranial symptoms, he (Mr. Tod) advised against operation and the man got well, had had no recurrence and was still at the hospital on duty. The President, together with Mr. Scott, once saw in consultation with him a colleague who had acute streptococcal infection of the mastoid with involvement of the internal ear. He also developed sixth nerve paralysis, and at a very early stage had signs of meningitis, but nothing beyond the mastoid operation was done. Complete recovery took place and the patient was still in active practice, although completely deaf on the affected side. Another case which the President also saw in consultation was that of a child with an acute mastoid. Two or three days after the mastoid operation had been performed, paralysis of the external rectus occurred on the same side. More bone was removed along the roof of the tegmen tympani and towards the zygomatic process. Lumbar puncture was also practised with escape of excess of fluid, which was turbid, but no micro-organisms were found. The paralysis subsided in forty-eight hours, and within a week recovery was complete. Therefore there might be two conditions producing such paralysis, one a localized infection extending to the tip of the petrous bone: another due to increased intracranial pressure. In the discussion of such cases it had been suggested by Cushing that as the sixth nerve passed between the lateral branches of the basilar artery, the paralysis might be produced by the excess of fluid pressing down the brain stem, and so squeezing the nerve between the artery and the pons. The last case was probably of this type. The indications for treatment, therefore, seemed to be lumbar puncture and removal of the septic focus, especially the bone forming the tegmen tympani and the anterior group of cells extending along the roof of the meatus.

Mr. W. STUART-LOW said that the preceding year he had had a case of paralysis of the sixth, third, seventh and eighth nerves on the same side on which he had performed a radical mastoid operation, supervening six weeks afterwards. It was that of a young London policeman. He was much perturbed over him, and, as the pupil was implicated (dilated and sluggish to light) and he had headaches, vertigo, and weakening of the grasp on the same side, he was repeatedly moved to explore his brain, but in the absence of marked vomiting he desisted. As so many nerves were involved he suspected syphilis, although the Wassermann reaction was never conclusive; and under gradually increasing doses of potassium iodide these various paralyses and head symptoms gradually disappeared. He ultimately got quite well and returned to his duties. Mr. Stuart-Low said that before it was decided to open up the brain in such patients the possibility of a gumma on the dura mater or elsewhere should always be thought of.

Mr. WILKINSON said that some years ago he reported in the *Journal of Laryngology* (1914, xxix, p. 409) a case of meningitis in which there was paralysis of the sixth nerve for some weeks before the development of the meningitis. The patient had had a simple mastoid operation, and the temporal bone was of the pneumatic type, as was usual, he believed, in these cases. There was no increase of temperature, and the boy seemed fairly well, and was getting about the ward. The wound was quite clean, and had healed. At the end of six weeks, however, he had a sudden rise of temperature, and died, within two days, of acute meningitis. At the post-mortem an abscess was found at the apex of the petrous bone, which had pressed on the sixth nerve in Dorello's space, and in the meninges at the base of the brain a large collection of pus was found, a subdural abscess having perforated the dura mater. It must have been there some weeks. This showed the element of danger there was in these cases. Professor Gradenigo[1] was, he believed, the first to write on this type of mastoiditis, and he reported about sixty cases, of which only five came to post-mortem. Gradenigo insisted that the majority of the cases were of the pneumatic type, the cells extending into the apex of the petrous bone from the anterior part of the tympanum and the cells round the Eustachian tube. Severe and persistent pain on the same side of the head, but not specially localized in the ear or the mastoid, was a characteristic symptom.

The PRESIDENT said that one of the first cases of the kind many years ago he saw in private, was that of a girl aged 14, who had very severe headache, vomiting, and paralysis of external rectus. She had had glands removed from the neck, and a thin watery discharge was coming from the ear. When he opened the mastoid he found there was considerable tubercular caries, also granulations on the meninges. He did a lumbar puncture—one of the first he ever did, and a quantity of milky fluid emerged. He thought the child would die, but she rapidly recovered and became quite well. No organism was grown from the fluid. Another case was that of the son of a surgeon, a boy aged 15. He was at school, and had double acute otitis in an influenza epidemic: there was also some œdema of both mastoids. When he saw the boy he had a high temperature, and double external rectus palsy. He had been sick, his discs were pink and swollen, and he was obviously very ill. Both mastoids were at once opened, and a lumbar puncture done. Milky fluid came away, and it contained a large number of cells. No organism was grown from it. His experience was that if from the milky fluid organisms, such as streptococcus, were obtained, the patient usually died; perhaps he had seen one case of that kind recover. If no organisms could be cultivated from the fluid, however, there seemed a chance for recovery if lumbar puncture were repeated many times.

Mr. SYDNEY SCOTT said he had come to regard these cases in which there was paralysis of the sixth nerve as fairly common. All were familiar with the sixth nerve paralysis in cranial tumours when there was no lesion of the sixth nerve itself discoverable post-mortem. On the other hand, intracranial effusion was, nearly always, a marked feature of otitic cases which recovered, and he looked upon sixth nerve paralysis connected with ear trouble as a sign of increased pressure in the intracranial fluid. It did not necessarily mean there was a plastic exudation round the sixth nerve, though this might be found in cases which ended fatally from purulent adhesive leptomeningitis. The association of the sixth nerve palsy with increased pressure probably explained the great majority of Gradenigo's cases which recovered.

Dr. ALBERT A. GRAY said he thought that in the paper referred to, the effusion was said to have reached the sixth nerve immediately after it left the dura mater.

Mr. MOLLISON (in reply) said there was no question of syphilis in these cases; both were young boys, private cases. In both there was intracranial pressure; in one there was definite evidence of meningitis, cloudy fluid under pressure, and he regarded that pressure as the cause of the paralysis.

Mr. HUTCHISON (in reply) said that there were two kinds of case: in one, the infective process spread forward, and got at the sixth nerve in the space described in Dr. Guthrie's paper, quoted from Gradenigo. He took his own case to be one of these. The paralysis was present before operation, and the meningitis did not appear till several days after, when the temperature, which had been normal, both before and after operation, suddenly shot up to nearly 104° F., and vomiting and stiff neck supervened. He had explored forwards, towards the tip of the petrous bone, without finding the abscess; but perhaps he had not gone far enough.

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[1] *Archiv. f. Ohrenheil.*, 1907, xxxiv, p. 150.

Complete Bilateral Abolition of Acoustic and Vestibular Reactions following Cerebro-spinal Fever.

By ARCHER RYLAND, F.R.C.S.Ed.

R. L. R., aged 22. The history is that the hearing was normal when he joined the Army. Cerebro-spinal fever in France in November, 1917. On recovery complete deafness in both ears.

On examination: Tympanic membranes intact and appear normal; audition abolished; cochleo-palpebral test negative; Lombard voice-raising test negative; vestibular systems tested by rotation and irrigation, no response. On deceleration, after fifteen turns to either side, he is at once able to rise from the rotation chair and walk along a straight line the length of the room, 20 ft. Although intelligent he has not acquired any skill in lip-reading. No abnormality with regard to any other cranial nerve. He still has tinnitus. Romberg's sign negative. No vertigo, and he is able to walk quite steadily with eyes shut. Pointing test, and Babinski-Weil test, show no deviation. The restoration of equilibrium is exceedingly good. The right knee-jerk is diminished as compared with the left. Complete bilateral deafness with abolition of vestibular reactions.

The patient himself makes the following statement:—

"At Ypres, on the evening of November 4, 1917, I began to feel very sick with headaches and vomiting all night, but felt better in the morning and was able to go up to the line. But I got worse and worse until they had to send me back to billets when I went straight to bed, and sent for the medical officer and told him how I felt. At this time I started getting severe pains in my back and giddiness as if I was fainting. I must have been seriously ill as the medical officer never left me. He was continually talking to me, and asking me how I felt, until suddenly I could not hear what he said although I knew he was talking as I could see his lips moving. I seemed to get worse, as they sent for my C.O. and Padre. I remember later being removed to hospital and for about a month after that my mind is quite blank and I was told later that I was delirious. During this time I had eighteen lumbar punctures, as I learned afterwards from my chart. I left for England in February, 1918. I could not move my back at this time; I had to be lifted by blankets whenever I was removed. About April I started to walk, holding the back of a chair and pushing it up and down the ward. I could not do this for long even then as I got so tired and giddy and it made me so very weak. They found I had got a curvature of the spine and made me do physical exercises daily which did a lot of good and made me straight and strong. I was discharged in May, 1918, but remained in hospital until the end of that year."

Epithelioma of Auricle.

By Norman Patterson, F.R.C.S.

Man, aged 67. Nearly nine years ago this patient was operated on at Golden Square for epithelioma of the right auricle. He had a very large mass of glands in the neck. The auricle was removed and an extensive operation carried out in the neck, which entailed removal of a large portion of the sternomastoid and internal jugular.

There is a full description of this case in the *Lancet* of 1913, i, p. 962.

The President said Mr. Patterson was to be immensely congratulated on this case. His own experience of epithelioma of this region had been unsatisfactory. Early carcinoma of the pinna and antrum, with involvement of the glands of the neck, if treated in the manner Mr. Patterson had adopted, was a remediable disease; it was a wonderful case for no recurrence to have taken place. The reason was the thoroughness of the operation. The only way to get out the deep glands of the neck was to take away the internal jugular vein; in this case it was removed from the subclavian artery in the lower part of the neck to the base of the skull, and with it the glands and the sternomastoid. That type of operation he believed was the only one which would give, in such cases, a successful result.

Cirsoid Aneurysm involving the Temporal Bone and Neck.

By Norman Patterson, F.R.C.S.

L. P., female, aged 46.

Past history: Discharge from left ear since childhood; deafness in left ear since childhood; attacks of pain in left ear occasionally; facial paralysis, left side, six weeks; attacks of giddiness for three months. No nausea, no vomiting, no tinnitus.

On examination: Left ear—whisper not heard; Rinne + but shortened; Weber to right; bone conduction less than normal; aural polypus filling up external meatus; no tenderness over mastoid. Rotation test—right to left, no nystagmus; left to right, nystagmus four seconds. Right ear: Drum normal; hearing good.

First operation (August 16, 1920): Usual mastoid incision; tissues very vascular; post-meatal wall eroded, and bluish-grey polypus presented in wound. At this stage very severe venous hæmorrhage occurred from area of origin of polypus; wound packed tightly with gauze and left open.

Second operation (September 20, 1920): Mastoid re-explored.

Again very severe hæmorrhage, so that operation could not be completed; antrum not identified; wound plugged with gauze. No bleeding occurred in subsequent dressings.

Pathological report on polypus: Old inflammatory polypus with some hyperplasia of vascular endothelium from middle ear. No sign of malignancy.

January 11, 1921: Now a pulsating expansile swelling in left anterior triangle with systolic thrill. The left tonsillar region visibly pulsates. Left facial paralysis still present and paralysis of left vocal cord. Some paralysis left—hypoglossal. Pupils react to light, left slightly dilated; there is a corneal nebula present. Temporal pulses equal. No engorgement of veins of neck. Pressure on common carotid causes pulsation to cease.

DISCUSSION.

The PRESIDENT said that he saw a similar case in a child many years ago. She had had chronic otorrhœa a long time, and when brought to hospital she had a swelling in the neck, which had come on suddenly. She was taken into hospital for two or three days, and the swelling was obviously increasing. There was no bruit, but blood came from the ear, and he thought that ulceration of the internal carotid had occurred. The tonsil on that side projected towards the mid-line, as in the present case. He put a temporary ligature on the common carotid, and then worked up towards the internal carotid and put a ligature on that. Then he turned out the clot and plugged the opening in the base of the skull. The operation was remarkably easy. An opening in the internal carotid was visible close to the carotid canal. Pus had worked down to the base of the skull and ulcerated the wall of the internal carotid artery.

Mr. SYDNEY SCOTT said that he would like to emphasize that Mr. Patterson packed off the lateral sinus before he removed the growth. This greatly facilitated the subsequent steps in the operation on the neck. Only this week Mr. Scott removed from a very old lady a malignant growth which had begun in the meatus and had proceeded directly backwards across the inferior part of the mastoid, without invading the tympanic cavity. It had extended to the lateral sinus, and this was the only part of the dura involved, and it could therefore be excised. After having packed off the sinus in the way Mr. Patterson had done, the operation on the parotid gland and neck was easy, because there was very little bleeding. He regretted to say the patient had since succumbed to bronchitis and heart failure, a risk which they had all foreseen but had failed to prevent. The growth, when examined histologically by Mr. Russell, proved to be malignant, and in parts was considered to have characteristics of the endotheliomata.

Mr. PATTERSON (in reply) said that when he wrote the article published in the *Lancet* in 1913 he suggested packing off the lateral sinus as a routine measure when there was a mass of glands high in the neck. The operation on the sinus only occupied about ten minutes.

Section of Otology.[1]

President—Sir CHARLES BALLANCE, K.C.M.G., C.B., M.V.O., M.S.

Demonstration of Pathological Specimens (Septic Meningitis).

By ALBERT GRAY, M.D.

Dr. ALBERT GRAY gave a lantern-slide demonstration illustrating the pathological conditions found in two cases of septic meningitis.

DISCUSSION.

Mr. G. J. JENKINS said it had always been difficult for him to find a track from the labyrinth into the meninges; it was therefore interesting to hear Dr. Gray definitely state that in this case it had been through the endolymphatic duct. His (Mr. Jenkins') habit had been to regard the infection as along the nerve, through the internal auditory meatus, but in all the cases of which he had microscoped specimens the maximum infection seemed to have been in the neighbourhood of the eighth nerve in the internal auditory meatus. That, however, was not evidence that it might not occur in another way.

The PRESIDENT said cases had been reported at the Section and at the original Otological Society in which infection was through the saccus endolymphaticus. In chronic disease, there was no doubt that infection occurred anywhere along the posterior surface.

Dr. A. GRAY (answering questions asked by Mr. Somerville Hastings and Mr. Sydney Scott) said that he knew cases of infection through the saccus endolymphaticus had been reported. He proposed now to make sections of the specimens he had just demonstrated. Cases were very rare, and a more common pathway of infection was through the internal auditory meatus. He could not be quite positive the infection came through the ductus endolymphaticus, but it came along the bony canal which contained that structure; it might, of course, have been external to the membranous aqueduct.

Injuries to the Ear in Modern Warfare.

By T. JEFFERSON FAULDER, F.R.C.S.

By LIONEL COLLEDGE, F.R.C.S.

THESE papers are printed *in extenso* in the *Journal of Laryngology and Otology*, June, 1921, pp. 277, 283.

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[1] At a meeting of the Section, held March 18, 1921.

A Device for Tuning Fork Testing.

Shown by E. A. Peters, M.D., F.R.C.S., and R. Lake, F.R.C.S.

THE device is for attachment to tuning-forks when testing bone-conduction. The greater the pressure on the bone the longer are the vibrations heard by the patient and this arrangement ensures the continuance of a certain known pressure. When the pressure is 8 oz. the fork is heard by the normal person twenty-nine seconds; when it is 16 oz. the sound is heard eight to ten seconds longer.

Two Cases of Lateral Sinus Thrombosis without Otorrhœa.

By W. M. Mollison, M.Ch.

Case 1.—Miss H., aged 20, was seen with Dr. R. E. French on July 18, 1920. Three to four weeks before, patient had pharyngitis, ? influenza. For the last fourteen days deaf in the left ear, and earache; no pus from the ear; for the last ten days great pain all over the left mastoid and occipital region. Temperature high, 104° F. on several occasions. No rigors. Examination: Left membrane dull, irregular; whispers heard at 2 in. only. Tender over mastoid and slight tenderness in the neck. Operation: Granulations in antrum and a line of granulations led backwards and upwards to the lateral sinus: on the sinus small collection of pus; wall resistant. Sinus opened backwards till bleeding met with at the junction with the superior petrosal sinus; internal jugular ligatured. Two days later re-operation, as the temperature continued high; sinus found thrombosed 1½ in. farther back; clot turned out and groove plugged as usual. Recovery. The point of practical interest was that the bleeding from the superior petrosal sinus at the first operation was sufficient to suggest that the limit of thrombosis had been reached, whereas clot really extended 1½ in. beyond.

Case II.—Mr. Y., aged 17, was seen on February 19, 1920, with Mr. Sheaf. Ten days before (February 10) the boy complained of earache (left); the temperature rose steadily till six days ago, when it was 104° F. Mr. Sheaf found the mastoid tender, but no otorrhœa, though there was some débris in the meatus; operated and found pus in the mastoid; exposed a very small area of the lateral sinus and thought it normal. Following operation temperature fell, but remained at 102°, 102°, 101°, and 103° F. on the four successive days. The boy looked very ill; tongue dirty; he had felt cold, though no actual rigors observed. The wound re-opened and the sinus exposed; passing from sigmoid to lateral sinus, in the angle between the posterior and middle fossæ, an extradural abscess was found; the groove was packed, the clot, which was not complete, turned out, and the internal jugular vein ligatured. Recovery.

DISCUSSION.

The PRESIDENT said these cases were of interest because there was no otorrhœa nor discharge from the ear in either case; and the description showed the treatment to have been quite typical and very successful.

Mr. G. W. DAWSON said he had seen, in the case of a child, suppuration of the mastoid when the tympanic membrane was normal. His idea was, that the child had inflammation of the tympanum and mastoid, but that the tympanic condition cleared up without suppuration, while the mastoid proceeded to the further stage. Perhaps the middle ear cleared up on account of the drainage afforded by the Eustachian tube.

Mr. SYDNEY SCOTT said that it was well that all should realize that such events as Mr. Mollison described did occur, and probably with much more frequency than was expected. Eleven years ago he published two cases of extradural abscess in which the tympanic membrane was never perforated; the drum was absolutely normal, and hearing was perfect. Not only had lateral sinus thrombosis occurred without any sign of suppuration in the middle ear, but brain abscesses, traceable to non-perforative otitis media, had been met with in which there were no signs of active middle-ear disease at the time the brain abscess was discovered. Yet post-mortem examination some time afterwards showed adhesions with a direct track between the abscess and some cells of the middle ear. About nine or ten years ago he had recorded in detail before the Section a rather similar case of a man who was an extreme example.[1] He had a retro-cerebellar abscess, without any active suppuration in the tympanum at the time he was under observation.

Sir WILLIAM MILLIGAN thought there might be a different explanation of this class of case. He considered it unlikely that such cases occurred without infection of the middle ear, though such infection might be of a transient nature, so that at the time of examination no actual evidence of it remained. He thought it possible for infection to be through the petro-squamosal sinus of a vestigial vein, which opened directly into the sinus after running across the tympanic roof. Such cases must, he thought, be very uncommon; he had seen very many cases of sinus thrombosis, but only one in which there was no clinical evidence of middle-ear disease. He had also seen cases such as Mr. Scott referred to, where there was no clinical evidence of the existence of middle-ear disease. In the few cases he had encountered the responsible organism was the same, the pneumococcus. It would have been interesting to know what was the causal organism in Mr. Mollison's cases.

Dr. H. J. BANKS-DAVIS reminded the meeting of a case in which the President (Sir Charles Ballance) opened a cerebellar abscess in a baby, pointing out that though the infant must have had middle-ear disease, there was then no rupture of the tympanic membrane. The child had stopped breathing, but on opening the abscess, breathing had recommenced.

Mr. MUSGRAVE WOODMAN (Birmingham) related a case in which he was rung up by a doctor, saying that he had a case of acute middle-ear pain, and asking whether puncturing the drum was advisable, remarking that he had the instruments if he could be told over the telephone how to use them. The case was seen a few hours later. It was that of a girl, aged 9, with acute pain over the left mastoid, and some swelling extending down the neck. The drum was slightly injected but not bulging, and there was no otorrhœa. Upon opening the mastoid the lateral sinus was found to be thrombosed and full of foul pus. The jugular vein in the neck was tied and the sinus drained, recovery being uneventful. Singularly enough he (the speaker) had operated upon the same child on the opposite ear four years previously, and in this case the lateral sinus was also thrombosed, but otorrhœa was present. In this case there was a curious anatomical position present on both sides, the sinus took a sharp bend forward at an acute angle, and in this position was separated from the mastoid only by a thin plate of bone.

Mr. W. STUART-LOW said that he had had to operate in a good many cases of mastoiditis, especially in children, where there was no discharge from the meatus nor evident involvement of the tympanic membrane; this was commonest in influenza where a fugitive otitis media had occurred. The infection in such cases passed rapidly on to the mastoid cells and caused pain and tenderness in the mastoid region. If left, these cases sometimes got well, but a great risk was run of severe purulent mastoiditis, meningitis, or other septic complications, chiefly thrombi in the veins. During the course of a long illness with lung and other complications, such as often arose in influenza, the blood tended to become thickened and the circulation slowed, especially in large blood spaces like the venous sinuses, and so thrombi formed from such blood changes alone, and any injury to these vessels and sinus walls, such as occurred from concussion during a mastoid operation, would increase this risk.

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[1] *Proceedings*, 1910-11, iv, p. 34.

Dr. GUTHRIE said it would be interesting to know whether influenza was the cause in these two cases: that disease was mentioned in connexion with the first case. The only instance he had seen of suppuration of mastoid cells with intact drum was in a case of influenza.

Mr. FAULDER said he had had a case of bilateral inflammation of the region of the mastoid, which cleared up on one side, but had to be operated upon on the other. There was no evidence of middle-ear disease on either side. The mastoid was opened, and was found diseased, and this was associated with abscess of neck glands on the same side.

The PRESIDENT said he had seen one case of acute osteomyelitis of the mastoid which had nothing to do with ear disease; it happened just as it might in any other bone in the body. He had seen three or four unusual cases following an attack of influenza. In these there had been a slight discharge from the ear, then the tympanum had healed, and the suppuration had extended backwards to the mastoid, the lateral sinus, perhaps to the brain; the process had been healing in one place and extending in the other. If one were called to such a case where the membrane had healed and was not red, a wrong history might mislead one, because it might be stated that there had never been a discharge. He thought there had been many cases in which healing had taken place outwardly, but a creeping suppuration had persisted until a vital spot was reached, such as the lateral sinus. He remembered the case of a ruddy, strong, healthy looking boy, aged 6, who came to the Children's Ward at St. Thomas', with a hare-lip. He (the President) cured the hare-lip, as he thought, very well. At the end of three weeks the sister said the boy was not well, and the wound of the lip, which had healed perfectly, was beginning to break down. There was no temperature, but the boy would not take his food. He went on in that way for ten days, with an occasional temperature of 99° F., but not more. Then many petechial spots were noted about the body. The ears and every part were examined, and some colleagues without success helped to try to ascertain what was wrong. It was some form of septicæmia, in which there was very little rise of temperature. The boy died. He had come up from the country perfectly well, had had a simple hare-lip operation done, and six weeks afterwards he was dead. Post mortem, extensive disease of the petrous bone was found, also of the mastoid; but there had been neither external œdema nor pain. There was suppuration in the lateral sinus. During the illness the ears were very frequently examined, but at no time could anything be found wrong with them; neither could the source of the septicæmia be traced. The internal organs were found to be covered with petechial hæmorrhages. There was the extensive disease of the petrous, without external suppuration, or evidence of it outside the drum. In children the drum was rather thick and white.

Mr. F. J. CLEMINSON said he had a case in which a boy, aged 10, was seen with a red fluctuating swelling over the right mastoid; he had a perfect tympanic membrane and normal hearing. At operation he found a fistula leading from the abscess cavity to the lateral sinus. The bone was carious over an area about 2 mm. across, and the track led down to a small area of granulations on the wall of the lateral sinus itself. The sinus was healthy, and a culture from the granulations proved sterile. He was at a loss to explain the case, unless it were an acute tuberculous osteomyelitis in the bone over the lateral sinus.

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SECTION OF PATHOLOGY.

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October 19, 1920.

W. S. Lazarus-Barlow, M.D. (President).

On some Pathological Effects of Exposure to the Gamma-rays of 5 grm. of Radium Bromide 1

The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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Section of Pathology.

President—Dr. W. S. Lazarus-Barlow.

On some Pathological Effects of Exposure to the Gamma-rays of 5 grm. of Radium Bromide.[1]

By W. S. Lazarus-Barlow, M.D.

On August 28, 1919, the Medical Research Council entrusted 5 grm. of radium bromide to the late Mr. Cecil Lyster (then President of the Section of Electro-Therapeutics), Professor Russ and myself for experimental purposes at the Middlesex Hospital. As the loan was at ten days' recall, the work has necessarily been carried out at somewhat high pressure both upon patients and upon animals, and a large variety of tissues is still under histological examination. By the kind consideration of the Medical Research Council, I may here adduce some of the more striking results obtained when animals were exposed to this intense bombardment with gamma-rays for prolonged periods. They are derived in the main from the examination of twenty frogs, twenty-eight rats, fifteen rabbits and nine cats. The work when completed will be presented as a Report to the Medical Research Council. Sir F. W. Mott has undertaken to report upon the brains of the various animals and our senior secretary, Dr. Price-Jones, is investigating the bone-marrow of the rabbits.

Lethal Effects.—It is possible to kill an animal by irradiation alone, but it is necessary to recognize primary and secondary effects, though the two are not always easy to separate. The death itself seems to be due chiefly to secondary effects, for, though a rat dies under about forty-five hours' continuous exposure to 5 grm. of $RaBr_2$, at a distance of about 4 cm., death also occurs with fair regularity within two days after an exposure lasting six to twelve hours. Six hours appears to be about the minimal lethal exposure for the rat under these conditions. Whether the animal have died under continuous irradiation or have died some forty-two hours after an exposure of six hours the changes met with in the tissues are very similar. Nevertheless with prolonged irradiation the changes are more intense.

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[1] At a meeting of the Section, held October 19, 1920.

In comparing the minimal lethal dose in different animals the size of the animal is a factor. The radium is contained in a flat circular brass box, 14 cm. in diameter, and the intensity per unit of surface is fairly evenly distributed. But it is obvious that a frog, a rat, a rabbit and a cat exposed " as close as possible " will receive very different total amounts of irradiation and very different degrees of irradiation of specific organs. The fall in intensity of the radiation owing to distance has been determined experimentally by Professor Russ and, in the animal experiments (for which I am responsible), the distance has been taken as that which obtained between the surface of the radium box and the mid-point of the animal in a crouching position. Owing to the different arrangements adopted, the mid-point of the frogs and of the rats was distant from the $RaBr_2$, about 4 cm., the mid-point of the rabbits and the cats was distant about 15 cm. And since, at 4 cm. and 15 cm., the intensity of irradiation has fallen to about 66 per cent. and 13 per cent. respectively, it follows that an exposure of one hour at 4 cm. is equivalent to an exposure of five hours at 15 cm.

When these corrections have been made an extraordinary difference is observed between the cold and the warm blooded animals, for the frog will support some twelve to twenty times as much gamma-radiation as the rat, rabbit or cat. As to the latter animals it is not safe to dogmatize. The minimal lethal dose for the rat at 4 cm. is about six hours, while for the cat, at 15 cm., it is about twenty-four hours, and for the rabbit, also at 15 cm., it is about forty-eight hours. These values corrected for the fall in intensity at the two distances indicate that under similar conditions when the minimal lethal exposure for the rat is six hours, for the rabbit it is nine to ten hours, and for the cat it is five hours. Hence it may be assumed provisionally that these three types of animal are not equally susceptible to gamma-radiation. The cat, in particular, gives the impression of being highly susceptible.

Cytological Appearances in General.—If the cell be considered in respect of its nucleus, its cytoplasm and any paraplastic material it may contain, marked changes may be found. The nucleus may stain faintly and diffusely (endothelium), deeply and diffusely (spermatogonia), faintly and with a few dust-like particles of chromatin (striated muscle), moderately and with a single large nucleolus and a few particles of chromatin (liver), faintly and with a few relatively large particles of chromatin (kidney), and in many cases it is impossible to determine whether the appearances are normal. But in some cases it is certain that the nucleus is abnormal. It may be converted into an empty sac (columnar cells of intestine), or may be irregularly vacuolated (striated and unstriated muscle, bone-marrow), or may be "ghost"-like (liver, kidney, muscle), or the nuclear membrane may have disappeared leaving only a small constellation of chromatin points (kidney, liver), or the entire nucleus may have become broken up into deeply stained débris (lymphocytes, intestinal mucosa), or, finally, all traces of a nucleus may be lost, though cytoplasm persists (liver, kidney). In the case of neoplasms, any of these appearances may be met with, but most frequently the chromatin is gathered into an irregular mass situated more or less in the middle of an enlarged, irregular and often vacuolated spheroid.

Even under normal conditions mitotic figures are rare except in intestinal mucosa and testicle. In the case of animals that have been killed immediately after a relatively short exposure the cells of the tubular glands in the intestine may show irregular masses of deeply stained chromatin representing mitotic figures, but they are usually absent from testicle. If the animal have been subjected to a more prolonged exposure, or have been allowed to survive for some days, probably no trace of mitosis will be found even in intestinal mucosa.

The cytoplasm may be hyaline and basophil, oxyphil or indifferent (pancreas), translucent and oxyphil (gastric mucosa), vacuolated (bone-marrow, kidney, unstriated muscle), or it may be converted into mucus (intestine, trachea), or show fine granules (salivary gland), or globules of lipoid (adrenal, convoluted tubules of cat), or, rarely, it may show neutral fat globules (tracheal cartilage, paraortic tissue of rat, kidney of cat). Of these modifications the intense mucoid change in intestine and the lipoid change in kidney of cat will be referred to later. But perhaps the most striking change of cytoplasm seen after exposure to a large quantity of radium is its complete disappearance. In this case the nucleus is left suspended, as it were, in the middle of a cavity limited, at some distance, by the cell membrane which, now, is unusually conspicuous. Since the condition is most marked in animals that have survived for some days after a somewhat severe exposure, this disappearance of cytoplasm must be regarded as secondary. It has been found chiefly in cells of liver and of mammary carcinoma.

Including zymogen granules and mitochondria under the general name of paraplastic material, little can be said with certainty. In salivary glands of serous type, fine basophil or oxyphil granules are present ; in liver and pancreas, somewhat coarse granules are often closely packed in the cells ; in peptic cells of stomach there is a fine basophil granulation. and in the oxyntic cells, a small amount of fine oxyphil granulation. But these appearances cannot be distinguished from the normal. With regard to mitochondria, the uncertain nature of the objects designated by this name renders observations in regard to them of doubtful value, particularly if negative. I have found them in liver and kidney and, doubtfully, in specimens of intestine in rats that had been exposed for sixteen hours, but I am not convinced that they are present in other varieties of cells examined.

The Blood System.—A rapid examination of the blood within blood-vessels in histological specimens from various parts of the body shows few apparent changes in the erythrocytes but a complete or almost complete absence of leucocytes. Closer examination indicates that the red blood corpuscles are generally of good shape but stain poorly with eosin, that homogeneous non-cellular coagulum often occupies a portion of the lumen and that the deficiency in leucocytes principally concerns the lymphocytes. With a very severe irradiation prolonged search may fail to reveal a single lymphocyte or polynuclear cell. Under less severe conditions the lymphocytes may be wanting completely but polynuclear cells may persist in fair numbers. This difference in effect of radiations upon the leucocytes of the circulating blood is well known, largely as the result of the work of Russ, Chambers, Scott and Mottram in this country, and of Murphy and others in America.

I do not know of any published observations respecting the erythrocytes, but there is no doubt that they undergo marked destruction. Thus, in the rabbit I have found that exposure to the 5 grm. of radium for three successive periods of sixteen hours separated by eight hours' intervals was associated with the changes of red corpuscles shown in the table (p. 5).

Similarly in man an exposure for six hours has often been followed by a small erythrocytic fall, but a fall does not occur with the same regularity as in the rabbit. This is explained in part by the size of the human body and the smaller dose administered. Other factors at work are shown by the considerable fall in the erythrocytic count that sometimes occurs with a six hours' exposure. In a case of lymphocythæmia an exposure of six hours over the spleen was followed by an immediate

ERYTHROCYTES.

Rabbit		Before Irradiation	After first exposure	After second exposure	After third exposure	Remarks
(I)	Number per cubic millimetre	9,100,000	8,460,000	7,680,000	6,940,000	Minimum occurred immediately after third exposure
	Hæmoglobin	66 per cent.	59 per cent.	77 per cent.	67 per cent.	
	Index ...	0·37	0·44	0·52	0·41	
(II)	Number per cubic millimetre	8,340,000	8,280,000	9,300,000	7,340,000	Ditto
	Hæmoglobin	72 per cent.	68 per cent.	60 per cent.	64·5 per cent.	
	Index ...	0·43	0·41	0·32	0·44	
(III)	Number per cubic millimetre	8,960,000	8,300,000	7,640,000	6,100,000	Minimum occurred on sixteenth day after third exposure
	Hæmoglobin	76 per cent.	68 per cent.	71 per cent.	66 per cent.	
	Index ...	0·42	0·41	0·47	0·54	
(IV)	Number per cubic millimetre	7,380,000	8,000,000	8,800,000	5,800,000	Minimum occurred on seventh day after third exposure
	Hæmoglobin	78 per cent.	74 per cent.	74 per cent.	68 per cent.	
	Index ...	0·50	0·46	0·42	0·59	

drop from 3,040,000 red blood corpuscles per cubic millimetre to 1,831,000 per cubic millimetre, and within twenty-four hours to 1,509,000. The lowest value was 1,415,000 per cubic millimetre forty-eight hours after exposure. There is also reason to believe that any relatively small destruction of red corpuscles is rapidly masked by an increased production in the bone-marrow. Below are given a few examples of diminished erythrocytic blood counts in patients exposed for five to six hours for malignant disease.

Case	Before exposure (millions per cubic millimetre)	After exposure (millions per cubic millimetre)	
		A	B
1	4·4	4·6	4·0
2	4·8	4·5	—
3	5·0	4·1	4·5
4	5·8	5·4	5·3
5	5·5	5·0	5·6
6	5·2	4·8	5·0
7	4·8	4·7	3·8
8	5·4	4·9	5·4
9	5·2	5·2	4·8
10	5·8	5·7	5·3
11	6·0	5·6	5·4
12	5·3	5·2	5·0

A = Observation two days after exposure. B = Observation seven days after exposure.

However, during the same period over which the above cases were observed eight other cases showed no significant change or a slight rise.

As to the actual changes undergone by the red blood corpuscles it is a little difficult to speak. With a destruction such as is indicated by the figures for rabbits given above, it might be expected that hæmoglobinuria would occur or that corpuscular débris or hæmosiderin granules would be found in some of the tissues. Of hæmoglobinuria or of hæmosiderin there is no evidence, even when the animal has died under continuous irradiation. But many of the animals show in the liver widely dilated capillaries with partially or completely disintegrated red corpuscles. The same fragmentation may be present in the spleen, but a further stage of the process represented by endothelial cells crammed with particles of dark brown pigment is relatively uncommon. In the bone-marrow macrophages full of erythrocytic débris are often seen. In the case of leucocytes the most recent work upon the effect of gamma-radiation is that of Mottram and Clarke. Both in man and rabbit am I able to confirm their observations that a diminution in the number of circulating leucocytes obtains and that this principally concerns the lymphocytes. The effects of gamma-radiation are therefore similar to those of X-radiation. In the four rabbits mentioned above that were exposed to 5 grm. for three successive periods of sixteen hours separated by eight hours' intervals, the leucocyte counts were as follows:—

Absolute Numbers of Leucocytes per Cubic Millimetre.

Rabbit	Before irradiation	After first exposure	After second exposure	After third exposure	Remarks
(I)	5,900 L. 3,658 P. 885	6,050 L. 1,119 P. 3,710	5,600 L. 784 P. 4,312	2,700 L. 392 P. 1,849	Minimum occurred immediately after third exposure
(II)	6,400 L. 2,752 P. 1,088	10,400 L. 520 P. 9,464	5,900 L. 354 P. 5,487	3,900 L. 117 P. 3,607	Ditto
(III)	9,600 L. 3 216 P. 3,744	8,000 L. 1,040 P. 6,400	5,800 L. 2,726 P. 2,088	2,000 L. 1,180 P. 160	Minimum occurred on sixteenth day after third exposure
(IV)	9,600 L. 5,904 P. 2,496	4,500 L. 45 P. 4,363	4,000 L. 400 P. 3,440	3,200 L. 128 P. 3,040	Minimum occurred on fifth day after third exposure

L. = Lymphocytes. P. = Polynuclear cells.

The paucity of histological evidence for what is undoubtedly an enormous destruction of red blood corpuscles is paralleled by the case of the lymphocytes. If an animal be killed immediately after a somewhat prolonged exposure (e.g., a rat, after sixteen hours), the sole positive histological evidence of a lymphocytic destruction which is so enormous that very few indubitable lymphocytes are to be found in blood or spleen or lymphatic gland, is the presence of a moderate amount of nuclear débris in lymphatic glands and spleen. Even this nuclear débris rapidly disappears, for probably traces alone will be found if the animal have been allowed to survive the exposure by one or two days. If the exposure have been for three hours and therefore non-lethal, the lymphopænia will be entirely unassociated with any obvious nuclear débris.

Nevertheless, an important associated phenomenon exists in diminution in size of the spleen. Since the spleen is roughly triangular in cross section my estimate of its cubic content is half the product of its length, breadth and height, and I divide the value thus obtained by the length of the extended animal from tip of nose to root of tail. Below are given some mean values obtained in rats and expressed in the form of cubic centimetre of spleen per centimetre of length of animal :—

Spleen of nine control rats (non-radiated) = 0·072 c.c. per centimetre of length.
Spleen of twelve rats exposed for three hours = 0·0358 c.c. per centimetre of length.
Spleen of ten rats exposed for twelve or more hours = 0·0182 c.c. per centimetre of length.

The splenic condition is progressive, for, if the twelve rats exposed for three hours be divided into classes according to the length of their survival after irradiation, the values are as follows :—

Killed immediately after exposure, spleen = 0·0521 c.c. per centimetre of length.
Survived three days after exposure, spleen = 0·0322 c.c. per centimetre of length.
Survived six days after exposure, spleen = 0·0287 c.c. per centimetre of length.
Survived nine days after exposure, spleen = 0·0157 c.c. per centimetre of length.

In lymphatic glands, apart from the deficiency of lymphocytes and the presence of nuclear débris, cells may be relatively so sparse that wide channels are left, particularly towards the periphery. These channels may be almost empty or may contain large endothelial cells whose cytoplasm is packed with fine, black or brown pigment granules, or red corpuscles may be present in numbers so great that a hæmolymph gland results. When some days have been allowed to elapse before killing the animal after a moderate exposure, plasma cells may be present in enormous numbers; except for a few endothelial cells they may be the sole variety recognizable.

As regards the bone-marrow, Dr. Price-Jones permits me to say that he finds destruction of white cells with hæmorrhages into the bone-marrow and phagocytosis. He considers it probable that the results should be regarded as a combination of white cell destruction, diminished or inhibited formation of granular leucocytes and exaggerated red cell production in response to the numerous hæmorrhages and phagocytosis of red cells by the large mononuclear cells.

In accordance with this finding the numbers of leucocytes in the circulating blood progressively diminish. However, the diminution in numbers of granular leucocytes in the circulating blood always lags behind that of the lymphocytes owing to the fact that the granular cells are reinforced by preformed polynuclears washed out from the bone-marrow, whereas the factories of lymphocytes (spleen and lymphatic glands) are profoundly damaged from the first. Indeed the contrast between the apparently stimulated activity of bone-marrow and the depressed activities of the spleen and lymphatic glands is one of the most striking phenomena produced by exposure to a large quantity of gamma-radiation.

The Muscular System.—I have selected as striated types the muscles of the anterior abdominal wall, the adductor magnus, the biceps and occasionally deep muscles of the neck or thorax. As non-striated types have been chosen, the external, internal and mucosal muscular coats of stomach, duodenum, jejunum, ileum, colon, rectum, the muscular coats of arteries and arterioles and, in females, the uterus and Fallopian tube. In the case of heart, various parts have been taken without special selection. As might be expected, differences are seen in the changes undergone by voluntary, involuntary and cardiac muscle. But it was somewhat surprising to find that differences obtain even in the single group of striated or unstriated muscles. And it was even more surprising to find that normal bicipital muscle, for example, may generally be diagnosed from abdominal muscle by the relative shortness and thickness of its nuclei, and that the internal muscular coat of the small intestine often shows a diminishing basophilia of its contractile material until the basophilia becomes replaced by oxyphilia in the lower part of the ileum or upper part of colon. The points just mentioned it is impossible here to discuss, but clearly they would repay further research.

Striated Muscle.—The most striking modifications are: (1) Irregularly deficient striation; (2) a transparent or vitreous change; (3) a lipoid change in individual fibres of a bundle seen in some cases; and (4) vacuolation or other changes of muscle nuclei.

Without doubt deficient striation and the translucent appearance are in part artificial in origin and occur independently of irradiation, for they are met with in the muscles of control and non-radiated animals, often to a considerable degree. Nevertheless the muscles of animals exposed to 5 grm. of radium show the changes in a more marked degree, and abdominal muscle is particularly liable to be affected. If the muscle be examined fresh, or frozen sections be made after hardening in 10 per cent. formol saline, striation in general is better, but nevertheless in many fibres it is poor or completely absent. Staining with Sudan III shows that fibres without striation take up the dye somewhat, whereas their fellows which show striation are almost unstained. Further, such altered fibres frequently show minute red globules of lipoid which may lie in parallel lines similar to those of striation, or may be irregularly disposed. This lipoid deposit is invariably dust-like, and is completely absent from normal muscle and from most animals which have been killed immediately after a moderate radiation. It appears to develop with time, and I have found it in the great pectoral muscle of a woman whose breast was amputated for malignant disease six weeks after a local exposure to the 5 grm. of radium bromide for six hours. That a lipoid change is demonstrable indicates that the fibres are damaged, and supports the view that the loss of striation and the translucent change noted in muscle that has passed through the paraffin process are not wholly artificial in origin. Here it may be noted that all animals exposed for rather long periods to the intense gamma-radiation now being considered develop a marked sluggishness of movement for some days before death.

Unstriated Muscle.—The contractile substance is often conglomerate, semi-translucent, and shows complete absence of fibrillation. In the coat of the stomach and to a far less extent in other situations it may be vacuolated. Indeed in the stomach a coarse sieve-like arrangement may obtain. The vacuoles sometimes hold a nucleus attached to part of the wall, but commonly vacuolation occurs in the non-nuclear portions of the contractile material. The nuclei of unstriped muscle may be faintly stained and vacuolated, or may be deeply stained, linear and sinuous or irregularly contorted. No special changes have been noted in the case of blood-vessels other than those common to unstriped muscle in general. In the Fallopian tube the nuclei are very closely packed, with the result that little contractile material is seen. The muscle stains particularly well, and the nuclear definition may be sharper than in non-radiated control animals. Nevertheless there appears to be muscular deficiency similar to that which obtains with striated muscle, since, after a prolonged exposure, death with abortion occurred in a pregnant cat, but the dead fœtuses were only partially expelled. A similar deficient power to expel their contents obtains in the case of intestine.

Cardiac Muscle.—Practically no change is found in cardiac muscle, unless the exposure have been enormous or the animal have been allowed to survive some days after a very severe exposure. When present the minimal change appears to be translucency of occasional fibres with complete disappearance of all striation. In more advanced cases there is vacuolation of the contractile substance, and in still more advanced cases intense fragmentation. Under the last two conditions, vacuolated or vesicular or "ghost-like" nuclei may be seen, and sometimes even nuclear débris with disappearance of the nuclear membrane. But as a rule the muscle nuclei differ little from the normal.

In neither cardiac nor unstriped muscle has a lipoid deposit been found similar to that occurring in striated muscle.

Liver.—The liver rarely shows any divergence from the normal. Sometimes the microscopic section appears to be normal, but more careful study shows that the nuclei have greatly diminished in numbers, "ghosts" and foci of nuclear débris being common. At other times the cytoplasm of the hepatic cells has almost entirely disappeared, and it is in these cases that a nucleus lying within a ring of cell membrane without visible cytoplasm is met with. When this condition occurs it is usually so extensive that the section of liver can hardly be recognized as such under the microscope. It has been met with in frog, rat and rabbit, and is apparently a late secondary change after a severe exposure. It is generally distributed throughout the organ, but does not lead to any macroscopic changes. Unless the hepatic disorganization be very great the blood-vessels and bile-ducts stain sharply. The nuclei of the vascular endothelial lining stain well, but those of the columnar cell lining of the bile-ducts are usually vesicular and stain with extreme faintness.

Kidney.—The most striking renal change is that which occurs in the cells of the convoluted tubules of the cat. Frozen sections stained with Sudan III show an intense lipoid deposit confined to this portion of the urinary system with remarkable strictness. No trace of lipoid is seen in the glomeruli and where the convoluted passes into the conducting portion of the system of tubules, the lipoid deposit ceases abruptly. Staining with osmic acid yields a general grey-green colour of the globules, and jet-black globules are few. Similarly with Nile blue sulphate, red drops are few and there is little more than a pale lilac coloration of the convoluted tubules. Neutral fat, therefore, is not present in any great quantity. It must be allowed that lipoid changes are common in the kidney of the cat, but, under intense gamma-radiation, they are present to such an extent that the tubule seems to be entirely composed of lipoid. In sections that have passed through the paraffin process, the lacunæ resulting from removal of the alcohol and xylol-soluble constituents are so numerous that the tissue is sieve-like. In this respect it resembles the inner muscular coat of stomach, but there is no evidence that vacuolation in the case of unstriped muscle is preceded by a lipoid change. No other of the animals used in this investigation have manifested the same change, but it may be noted that the kidney of a woman who had had two exposures, each of six hours, to 5 grm. of $RaBr_2$, for carcinoma of the œsophagus and died shortly afterwards, showed a small degree of lipoid change in the convoluted tubules.

In spite of the fact that frog, rat and rabbit do not show lipoid deposit it must not be assumed that they present no renal changes. On the contrary there is considerable breaking down of the cytoplasm of the renal cells in all the animals and in them also the convoluted tubules are the chief seat of change. Sometimes the cells are entirely desquamated, but if the exposure have not been too severe, that portion of the cytoplasm internal to the nucleus is broken down, and the lumen of the tubule is bridged or blocked by albuminous material. The nuclei are often fairly preserved when the general destruction of cells is limited to the inner portion of the cytoplasm, but in severer cases large numbers are "ghost"-like or may have broken down into débris or may have disappeared altogether.

The conducting tubules do not show very definite changes except in severe cases; in this respect, they conform to the general rule that, under irradiation, cells of which the prime function is secretory suffer more than cells of which the prime function is to line a duct. The frog is the only animal in which changes of definite significance have been met with in the glomeruli. After prolonged exposure, the glomerular tuft in the frog undergoes a conversion—partial or complete—into a hyaline, swollen material which recalls the lardaceous change of the glomerulus in man. At the same time the glomerular space shows much homogeneous, albuminous coagulum or rarely some red blood corpuscles. This gives the impression of a change affecting blood-vessels and blood. The glomerular change in the frog is accompanied by intense destruction of the tubular epithelium. Frequently too, in this animal, there are collections of cells resembling plasma cells in the stroma of the organ generally; nothing of like kind has been met with in any of the other animals that have been examined.

The kidneys of all animals that have been exposed to intense gamma-ray action are congested, and sometimes the glomerular capillaries are dilated, but evidence of actual extravasation is rare other than the occasional presence of a red blood corpuscle in the glomerular space. Casts of any kind are very rarely seen, and in the numerous cases in which tubules are blocked it is by the local desquamation and destruction of the renal cells themselves, aided possibly by some serous exudation from the neighbouring capillaries and venules.

Gastro-intestinal Tract.—The gastro-intestinal mucosa shows changes in all animals used for investigation. With less severe exposures a certain amount of desquamation in the tubular glands of the stomach, or an excessive mucus-formation in the columnar epithelium of the intestine, is noted. With more severe exposures, extensive hæmorrhages, intense mucoid degeneration and desquamation of gastric mucosa occur, along with sloughing of the intestinal mucosa.

Probably the hæmorrhages are primary, for hæmatemesis has occurred in a man four hours after the commencement of a therapeutic exposure to the 5 grm. for recurrent sarcoma of the inguinal region. Moreover in animals, the gastric hæmorrhages are part of a general tendency to extravasation, though, admittedly, such extravasation frequently appears to be most extensive in the stomach. Similarly, the excessive mucus-formation is primary; it is associated with the formation of goblet cells in numbers so large that it may be difficult to find a single columnar cell in a section of colon. On the other hand the sloughing of intestinal mucosa is certainly secondary though it occurs with great rapidity. It is most marked in duodenum and jejunum but may extend into ileum and patches of slough may occur anywhere in the large intestine. The entire mucosa may be affected, but it is commoner for the tips of the villi to be entirely denuded of epithelium (so that the more or less altered connective tissue stroma projects into the lumen of the gut) and for remnants of the blind ends of the tubular glands to persist close to the muscularis mucosæ.

The connective tissue is often the seat of a plasma cell infiltration, and the fact that in this tissue changes are less marked than in the secretory system so intimately incorporated with it, is always obvious. In the stomach of the frog the connective tissue layer intervening between the main and mucosal musculature may undergo a complete mucoid change, so that it comes to resemble the tissue of umbilical cord or a myxoma in its histological structure. In higher animals, prolonged exposures, especially if the animal have survived some days, are sometimes associated with a collagenous condition of the connective tissue similar to that which characterizes the subcutaneous tissue in the region of a gamma-ray burn. The changes occurring in the muscular coats of stomach and intestine have already been mentioned.

The general effect of the changes that have been described above is interesting. Apart from the hæmorrhages, which are only met with in very severe cases and lead to the presence of altered blood in the intestinal contents, the alteration of the intestinal mucosa, together with the increased mucus-formation, leads to diarrhœa (usually of an intensely mucous variety) so long as the intestinal muscles have not become damaged to such an extent that they can no longer urge forward the contents of the bowel. Hence mucous diarrhœa is an early result of the severe exposures to gamma-rays now under consideration. But, when the muscular coats have become so altered by vacuolation of nuclei and contractile material, by the translucent change and perhaps by alterations in their normal degree of basicity that their normal peristaltic contractions cease, the diarrhœa ceases also. Nevertheless the mucus continues to collect within the gut so long as there are columnar cells from which it can be formed and, therefore, at death, the entire large, and much of the small, intestine is filled to a greater or less extent with relatively clear mucus similar to that forming the evacuations in mucous colitis of man.

It is noteworthy that intestinal changes of like kind to those described above, but less intense, have been found in some cases in Germany, in which death followed a course of deep X-ray therapy for uterine fibroids.

The Generative System.—Very probably, from our knowledge of the influence of X-rays upon the sex glands, radium-rays also exert a somewhat similar influence. Moreover from unpublished experiments of my own, I have reason to believe that small quantities of radium enclosed within the rat's abdomen for a period of months under conditions in which the beta and gamma-radiation is constantly acting upon sex glands, lead to a most profound degree of atrophy.

Nevertheless evidence that the gamma-radiation from 5 grm. of $RaBr_2$ acts upon testicle and ovary is meagre and under any circumstances it is not of a gross kind. Probably this is largely to be explained by the short survival after an exposure of some hours.

In the testicle of the frog (the experiments were conducted between March and May) I could not find any appearances ascribable to the action of the radiations, even in animals that had been exposed for ninety-six consecutive hours or even longer. In radiated, as in non-radiated animals, the cells at the periphery of the tubules were ill-formed and stained very faintly, but the sheaf or fan-like masses of spermatozoa were intensely basophil and normal in shape and arrangement. In particular there was no evidence that the spermatozoa were losing their intense avidity for the basophil dyes. Nevertheless the fact that radium acts on the spermatozoa of the frog in a physiological direction was shown conclusively by Hertwig.

In rat, rabbit and cat the usual great variety in appearance of the constituents of the seminal tubules, according to the stage in spermatogenesis, was noted, but in radiated animals, spermatids or spermatozoal heads were sometimes seen in which the normal basophilia had given way to indifferent staining or even to oxyphilia. The nuclei, too, of spermatocytes were more faintly stained than usual, and showed a greater tendency to chromatolysis and disintegration. Spermatogonia still showed small round nuclei with intense and diffuse basophilic staining and cells of Sertoli their faintly stained, large, oval nuclei. Spermatoblasts, with their fan-like groups of spermatids or spermatozoal heads were similar in non-radiated or in radiated animals.

On one point there is certainty, and this lies in the complete cessation of mitosis throughout the testicle. Even skein-like arrangement of the nuclear chromatin in prophase or metaphase is not seen in frog or rat, though present in rabbit and cat. Such spermatozoa as were already in existence within the organ seem to have undergone no greater visible change than that which is indicated by their occasional change in staining reaction. But spermatogenesis has been completely arrested. Whether this arrest be temporary or permanent must surely depend upon the length of exposure. Upon this point I have no evidence, for I have not been able to convince myself of any difference in the microscopical appearances of the testicle dependent upon length of exposure or survival after exposure. The point could only be settled satisfactorily by means of breeding experiments.

The epididymis shows a well-marked ciliated columnar epithelium, the cilia being long and the cytoplasm of the cells being scantier on that side of the nucleus towards the lumen and denser again just beneath the cilia. Within the lumen of the tubules are spermatozoa, in which the staining of the heads is usually less basophil than in non-radiated animals. Thus the epididymis of a severely exposed animal cannot be differentiated from that of a normal control except possibly by the contents of the tubules.

In the ovary the changes to be ascribed to the action of the gamma-rays are even less certain. Frog's ovary is useless for this purpose. In rat, and to some extent also in rabbit and cat, the great bulk of the ovary is made up of corpora lutea in varying stages of development and in these it is impossible to ascribe any particular appearance of cell nucleus or cytoplasm to the gamma-radiation. In the Graafian follicles and primordial ovules there is deficient staining and sometimes the follicles appear to be the seat of an accumulation of fluid or homogeneous non-corpuscular coagulum. Graafian follicles of good formation do not occur in the radiated animals. The ovarian stroma shows no differences from the normal.

The sex glands, therefore, are disappointing in a histological sense possibly by very reason of their high organization. Be that as it may, there is no doubt that parathyroid and adrenal, salivary glands and pancreas resemble the sex glands in their failure to present unequivocal evidence of marked histological changes under gamma-ray action; the same is true, in large measure, of the thyroid. And yet from clinical evidence it is certain in the case of the thyroid body and of the salivary glands, that the organs are affected by irradiation and it is at least possible from the evidence of altered enzymic action that the pancreas similarly undergoes change. Indeed, though one is ready to admit the fact of wide variations in the degree to which tissues manifest their reaction to the intense bombardment which has been the subject of the present investigation, one is loth to admit that any tissue can remain entirely unaffected and we are ready to ascribe any absence of recognizable change to the crudity of our histological methods.

The observations I have brought before the Section belong to a special branch of pathology that is now assuming a certain importance. Many of the changes I cannot recall to have seen under other than conditions of irradiation. From a general point of view it may be added that the measurements of the spleen given above seem to indicate that to the already recognized atrophy from disuse and atrophy from pressure it will now be necessary to add atrophy from irradiation. And in this connexion the changes met with after irradiation in normal bones and testicle, in thyroid of exophthalmic goitre, in uterine fibroids and in certain kinds of new growths, whether malignant or non-malignant, may well be remembered. Discussion of the point would lead us too far, but I commend the suggestion to your consideration.

DESCRIPTION OF THE FIGURES.

FIG. 1.

Stomach of frog exposed to the gamma-rays of 5 grm. $RaBr_2$ for twenty-one hours. Killed three days later. There is intense vacuolation in the contractile material of the inner muscular coat. The vacuole may carry a nucleus within it or on its wall. Paraffin, hæmatoxylin and eosin, × 200.

FIG. 2.

Liver of rat exposed for three hours. Killed nine days later. The cytoplasm has disappeared almost entirely from the hepatic cells, but the altered nucleus and the cell membrane persist. The same change is often seen in malignant cells in man after exposure to a large quantity of radium. Paraffin, hæmatoxylin and eosin, × 200.

FIG. 3.

Kidney of cat exposed to gamma-rays of 5 grm. $RaBr_2$ for sixty-four hours discontinuously. (Correction for distance in order to compare with Figs. 1, 2, and 4 yields an effective exposure of thirteen hours.) Died on the eighteenth day after first and eleventh day after last exposure. The cells of the convoluted tubules show numerous vacuoles representing the former situation of lipoid globules. The glomerulus (left) and a conducting tubule (bottom) show a complete absence of vacuolation. Paraffin, hæmatoxylin and eosin, × 200.

FIG. 4.

Colon of rat exposed for three hours. Killed nine days later. To show the great formation of mucus. The columnar cells of the tubular glands are almost universally converted into goblet cells. Paraffin, hæmatoxylin and eosin, × 200.

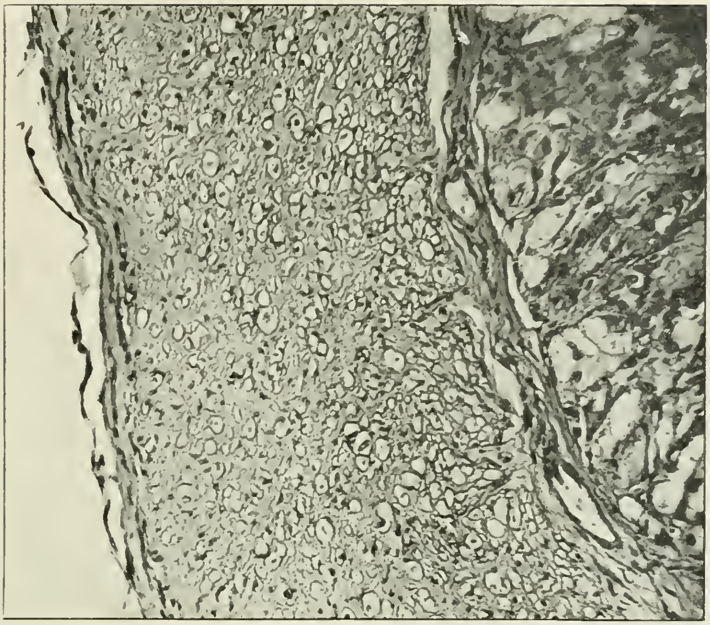

Fig. 1.

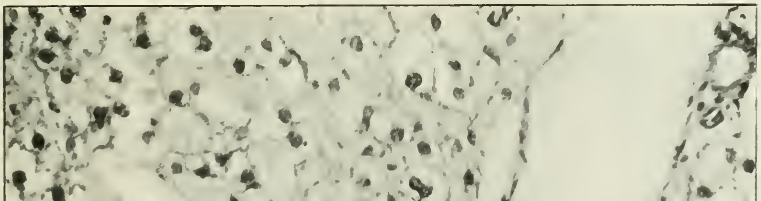

Fig. 2.

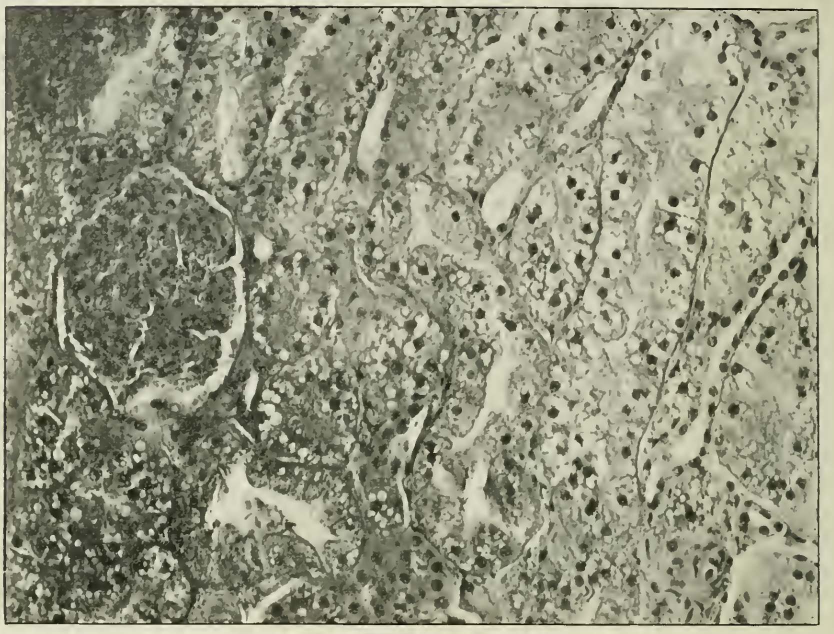

Fig. 3.

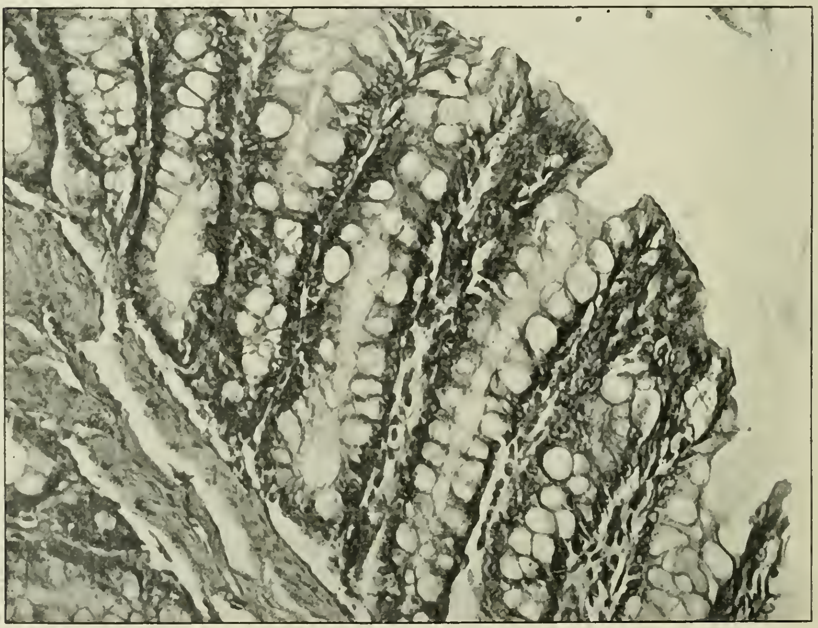

Fig. 4.

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1.

Section of Psychiatry.

President—Dr. E. Farquhar Buzzard.

PRESIDENT'S ADDRESS:

Some Aspects of Mental Hygiene.[1]

By E. Farquhar Buzzard, M.D., F.R.C.P.

The occupation of a presidential chair by one to whom the experience is new and unexpected cannot fail to have serious consequences on the mental attitude of the occupant. His sense of inferiority is unpleasantly aroused by looking back at the names of his predecessors in office, while his sense of reverence for presidents in general, a habit of mind which has grown with increasing years, is in danger of destruction. My pride in the honour which has been bestowed upon me is justly tempered by the knowledge that I owe my position, not to individual merit nor to eminence in psychiatry, but to the graceful and generous tribute paid from time to time by the members of this Section of the Royal Society of Medicine to their neurological brethren. This symbol of the cordial relationship between psychiatrists and neurologists is peculiarly happy in its appearance at the present moment. The borderland which separates and yet unites our respective territories has for some years past been the scene of an invasion by a somewhat heterogeneous multitude of students, the large majority of whom claim to be disciples of Freud and Jung. These invaders have not sprung only from the ranks of psychiatry and neurology, but in many instances have wandered from more distant realms of medicine and of science. As was inevitable in an unorganized movement of this kind, those taking part in it have not all been equally well armed. Some have lacked sufficient training in psychiatry and neurology, while others have been deficient in the critical faculty and the sense of proportion so necessary to scientific campaigns. It was equally inevitable, perhaps fortunate, that such an invasion should be neither peaceful nor silent. There have been pitched battles between the immigrants and those who considered themselves to be in possession. There have been noisy and unseemly squabbles among the new inhabitants, and this turmoil has been going on in the midst of an international and social upheaval which has brought into relief, perhaps as never before, the strength and the weakness of the human mind, its success and its failure in adapting itself to strange and distressful circumstances. It is not to be wondered at that while the storm provided an immense amount of material for study it created an atmosphere unsuited for well-considered judgments. The last year or two have, however, given us some leisure in which to review the origin, the progress, and the results of the new movement in psychology. I do not propose to enter upon a discussion of the merits or defects of our modern psychopathology and psychotherapy. In the first place I shall summarize shortly our present position ; in the second I shall consider how to use what is best and most firmly established of our knowledge, old and new, of psychological processes for the advancement of mental hygiene. In fulfilling my first purpose I shall be dogmatic. My opinions will not be acceptable to everybody, although they probably represent more or less accurately the views of many psychiatrists and neurologists.

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[1] At a meeting of the Section, held November 9, 1920.

Value of Psycho-analysis.

Psycho-analysis is essentially a method of scientific clinical investigation, and like all other methods of scientific investigation it requires in the investigator a trained and critical mind, and in the investigated subject a degree of intelligence rather above than below the average, if the results obtained are to be of value. As Dr. Henry Head has repeatedly insisted, it is impossible to investigate the problems of sensation on subjects of low intelligence. The information obtained from such an investigation may be useful for the purpose of diagnosis and treatment, but should not be utilized for the construction of general principles.

Psycho-analysis is as necessary for the study of psychiatry as accurate and patient history-taking is necessary for the elucidation of medical problems of organic origin. Psycho-analysis is not essentially a therapeutical measure. In certain cases it has a remedial value, either because it assists an intelligent patient to understand better, and therefore to deal better with, his mental disorder, or because it establishes a relationship of confidence between the doctor and patient which is helpful to the latter and which is the fundamental requirement in all successful psychotherapy. Psycho-analysis as a method of investigation has been the means of establishing a number of truths and principles which are of great importance in the study of psychiatry. As Bernard Hart has recently stated, in terms which can hardly be improved upon :—

> "A great number of Freud's conceptions have withstood all the tests that can be applied to them, and it is not too much to say that they are now firmly incorporated in the structure of our knowledge. How far other sections of his teaching are sound cannot yet be decided with certainty, but they are at least worthy of careful scientific investigation free from the dust of conventional prejudice. It *is* certain that Freud's work has opened a new era in psychology and psychopathology, and his introduction of the dynamic point of view—the conception of mental processes as the resultant of the action and interaction of great instinctive forces—has fertilized immeasurably the arid field of the old academic psychology." [1]

In claiming for Freud's work the opening of a new era in psychology Dr. Hart has not gone one step too far, although he is careful to reserve judgment on the merits of many conceptions which have rapidly followed the inauguration of that era. Psychotherapy is a convenient name applicable to all forms of treatment which depend on education, persuasion or suggestion, and not on physical or chemical influences, for their success. Although psychotherapy has been used by the medical profession for many generations, it has been recognized as a special method of treatment based on certain principles only within recent years. Its value in dealing with a large number of mental disorders can hardly be overstated, and it is for the future to determine the limits of its usefulness.

PRESENT POSITION OF PSYCHOTHERAPY.

The present position of psychotherapy, as well as the diseases from which it suffers—if a remedy can be the subject of disease—were admirably described by Dr. T. A. Ross in opening the discussion at the Cambridge meeting of the British Medical Association this year,[2] and I cannot refrain from endorsing his eloquent plea for the establishment of a more friendly spirit among those who practise and put their faith in different methods. If this brief description of our present position in regard to psychopathology and psychotherapy is accepted, we are justified in hoping for a great advance in the practice of mental hygiene in the not very distant future. I would include under this term all measures which aim at the prevention of mental disorders, whether they are in the nature of neuroses, psychoneuroses, or psychoses.

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[1] *Brit. Med. Journ.*, 1920, ii, pp. 623, 624.

[2] *Ibid.*, 1920, ii, p. 619.

Mental hygiene as a branch of medical science has been a miserable, neglected, and stunted plant, difficult to keep alive and still more difficult to rear, but it has a brighter future now that we are beginning to realize what it has lacked and to supply the necessary material for its development. It has always been the same in medicine. Hygiene in respect to tuberculosis was primitive and ignorant until the discovery of the tubercle bacillus. The prevention of sepsis was devoid of principles until the work of Pasteur and Lister paved the way. But if mental hygiene is to grow and to become robust the soil must be prepared, a congenial atmosphere created, and sufficient labour and material provided.

ORIGIN OF "NERVES."

Let me turn your attention to some of the weeds which have choked the plant we would see flourish. To my mind the strongest and most obnoxious is one which was sown in ignorance and has been nourished on fear. I refer to the fallacious belief, deeply implanted in the public mind and awaiting a long-delayed eradication by our profession, that so-called functional nervous disorders or "nerves" are not mental disorders. Surely the time has come to discard a verbal quibble which is unworthy of a scientific profession. There are signs in the air which lead me to think that unless we take this step ourselves the weed will be uprooted before our eyes by force of public opinion. But if we ourselves eradicate this weed we shall, in the first place, be able to speak quite as frankly about mental disorders as about gastric disorders, and to discuss psychotherapy as freely as we do diet. If we recognize, and cause to be recognized, that there are all degrees and kinds of mental disorders, we shall gradually but surely break down the barrier which at present separates "nerves" from insanity, and which preserves for the latter the position of a mysterious and malign ogre lurking in the background and ready to pounce upon its victims from an unseen world. No harm is or ever can be done by dispelling ignorance or clearing up mystery. The fear of insanity, the fear of the unknown, the fear of something coming on them without provocation and finding them defenceless, haunts a multitude of patients and prevents that peace of mind which is the first essential in restoring their "nerves."

Tell them that their symptoms are mental, that they have long suffered from a disorder of mind and familiarity will breed contempt in place of unspoken fear. By so doing you will remove the feeling of defencelessness, and promote a confidence that the condition is understood and that your treatment is not based on a wrong diagnosis. It is useless to tell a patient who is obsessed by the fear of insanity that he is only suffering from "nerves." In nine cases out of ten he will suspect either that you are deceiving him or that you are ignorant. Let him see that you recognize his symptoms as mental, and he will leave the treatment in your hands.

Needless to say, what I have here outlined is not sufficient. It is necessary to explain that what you mean by mental disorders are of everyday occurrence and in everyone's experience. You will instance the fact that you may suffer from an obsession which is dispelled by a night's sleep or by talking to a sympathetic friend; that such an occurrence is not a question of nerves, but illustrates a transient disorder of mind. Moreover, you must explain that although symptoms are mental they are not necessarily of mental origin. They may be due to other, more physical, causes, or to a combination of both. For this reason it is necessary to make both a physical and psychical examination, the latter perhaps including a careful investigation of the patient's past and present reactions to circumstances and environment. In these days you will hardly need to emphasize the fact that the condition of the teeth, of the lower bowel, or of the ductless glands may play a part, even if a subordinate one, in the production of mental disorder. It will take years before public opinion accepts the idea that mental disorders are among the commonest of ills and that we all suffer from them in a greater or less degree. But once insanity or madness is generally regarded only as an advanced form of mental disorder and not as an independent monster without relationship to other conditions, it will lose much of its frightfulness.

The theme I have entered upon could be pursued in many directions, but I can safely leave the trail to be followed by my audience. I am only concerned really with the plea that we should get rid of false terms such as "nervous" disorders when we mean "mental" disorders, and so clear the ground of the chief obstacle to rational mental hygiene. May I add that I am not preaching what I do not practise, and that I have seen no reason to regret the introduction of the word "mental" to patients when I have had the time to explain precisely what meaning I attach to it. In fact, it is a very necessary preliminary to the initiation of a course of psychotherapy.

Confusion of Ethical and Physiological Issues.

My next weed must be treated with more tenderness and respect. It has intimate relations with our plant and would almost appear to to grow on the same stem. Nevertheless it needs pruning and checking in certain directions if the sap of scientific hygiene is to be preserved. As there is difficulty in distinguishing the leaves of a tree from the ivy creeping over its branches, so is there confusion in mental hygiene between physiological and ethical issues, or—as I am in the habit of putting it to patients—between medicine and morality. Ethical doctrines based on religion are, speaking generally and in view of their antiquity, surprisingly useful in mental hygiene, but they need revision in certain particulars. The whole subject is too vast to admit of full discussion here, but I can make my meaning clear by an example which must be familiar to all of you.

A woman is beset by a fear or an anxiety or a sorrow—it does not matter which—but it is one which, according to her ethical upbringing, she must harbour in silence. She determines to suppress it and, again in accordance with her ethics, seeks success by throwing all her energies into some pursuit. Ignorant of physiological or psychological principles, she is surprised sooner or later to find herself beaten, and in the moment of defeat, when emotional reaction can no longer be restrained, she cries, "To think that I—I who always despised women with nerves—should come to this!"

Such a commonplace story illustrates two points of importance in relation to mental hygiene. In the first place, the patient has been brought up in ignorance of the fact that the mind, like the body, can be exhausted, and that an individual's endurance is a variable quantity determined by more than one factor. According to her ethical doctrine the success of her enterprise merely depended on the strength of her will. In the second place her piteous cry revealed the critical attitude of mind which, as a healthy person, she had always cherished towards those whom she had regarded as of inferior moral fibre. If her heart had become dilated as the result of prolonged and over-strenuous exercise there would have been no self-reproach. She would have gone to bed and received the visits of her friends with complacence and without a suspicion of shame. There must be something wrong with the training of youth if a story such as this is of everyday occurrence, and mental hygiene will not flourish in an atmosphere containing so much ignorance of psychological principles and so little charitable discrimination between medical and moral factors.

CREATION OF ENVIRONMENT FOR ADVANCEMENT OF MENTAL HYGIENE.

So far I have been concerned with two measures which appear to be essential in creating a healthy environment for the growth of mental hygiene. They may be summarized in very few words. Disorders of mind should be generally recognized as such, and the moral stigmata attaching to them should be dissipated. Such favourable conditions can only be created by the influence of the rank and file of the medical profession on the public. The time is ripe for a peaceful revolution of this kind. Both the profession and the public are more interested in psychological problems than ever before, and it only requires concerted and carefully considered action to direct this interest along healthy and beneficent lines. So far the increased interest in the mental side of our professional work has been reflected officially by the establishment of diplomas in psychological medicine, a step which should lead to valuable results by securing for this wide field of research a sufficiency of skilled labour.

But, personally, I do not want to see psychological medicine a special branch of a student's curriculum necessitating a three months' course in a special department. The student has more than enough to bear in the matter of special departments already. He need not be made familiar with all the writings, all the conceptions of Freud, Jung, or the older psychiatrists. He should learn from any or all of his medical teachers how to recognize, how to investigate, and the broad principles of treating, cases of mental disorder. Patients suffering from minor mental maladies will form the bulk of his practice when he is qualified, and, since mental hygiene is concerned principally with the young, the general practitioner of the future must be responsible for its success. He cannot depute these responsibilities to a medical officer of health appointed by municipal authorities. He alone can detect which child in a family is finding difficulty in adaptation to the realities of life or to environment. He only can decide whether a threatening neurosis or an incipient regression is due more to inherent defects in the child or to external causes. His treatment will need to be directed as often to the parents as to their offspring if he is to be successful in preserving the mental health of the latter.

Five-and-twenty years ago a student was taught to distinguish between organic disease and functional disorder in his patients. The diagnosis of organic disease was followed by a discussion on the ætiology and pathology of the condition, and the student was able to watch the effects of an elaborate regimen of treatment to its appropriate or inappropriate termination. The diagnosis of a functional disorder, really a mental disorder but not so called, evoked no comparable consequences. The page reserved for ætiology and pathology remained blank, and the treatment was either purely physical or consisted of a few mild exhortations.

> "You have no organic disease; you must not worry; you will recover in time; you must take plenty of exercise and have plenty of fresh air and good food."

This was generally accompanied by a good strong strychnine-containing tonic, which possibly stimulated an already exhausted patient to further unguided efforts on entirely unsuitable lines.

Recent acquisitions to our knowledge of psychopathology should have sufficed to make the methods I have described so crudely unrecognizable to the student of the present day. Still more do they encourage the hope that the number of victims of mental disorder may be appreciably diminished if modern principles of psychical investigation and psychotherapy are incorporated in general medical knowledge and do not remain the monopoly of a few specialists. The trend of events in our science always follows much the same lines. As soon as much knowledge has been acquired in any particular branch our thoughts are inevitably switched to the prevention rather than to the curative aspects of the problems involved. We are still seeking cures for cancer because we know so little about its causation. We are far more interested in the prevention than the cure of sepsis. Our profession has of recent years become more and more interested in the recognition of early signs of disease, or, rather, the signs of disordered function which precede structural changes. It is not too much to say that psychiatry can now join in this general pursuit and so promote the growth of mental hygiene.

MULTIPLE FACTORS IN MENTAL HYGIENE.

It may seem a far cry from the nightmare of a child who has supped not wisely but too well to the hallucinations of an asylum patient, and to put these two mental disorders in the same category might seem to be a bit of extravagance worthy only of a fanatic. But this nightmare incident illustrates well the tendency we all suffer from in greater or less degree to unify our pathogenesis. We like to think the nightmare was due to indigestion. It saves trouble, and the responsibility for preventing further nightmares may safely be left to the mother. There must, however, have been at least two other factors in the production of the nightmare. There was the inherent constitutional factor which caused that child to have a nightmare, although his brother, after consuming the same supper, slept undisturbed. There was the psychological content of the child's mind which determined the nature of the dream and the emotional disturbance associated with it. The most profound sceptic of modern psychology will not ask us to believe that the story of a dream is a bolt from the blue, or that it is more intimately related to the content of the dreamer's stomach than to that of his mind. The supper was undoubtedly important and may be allotted the chief share of guilt, but the other factors are not to be neglected if the study of mental hygiene in relation to children is to yield fruit. The asylum patient suffers from hallucinations. Shall we be content to say that he does so because he is mad? Or shall we look forward to the time when the reason for his suffering and the factor which determined the nature of his hallucinations are revealed to us? Looked at in this light, the problem of the nursery and that of the asylum are not so far separated.

The multiplicity of factors is a doctrine which as teachers we should keep constantly before the minds of our students. As practitioners our success depends on its observance whatever branch of medicine engages our interest. There can be no doubt that the study of epilepsy, for instance, has suffered much in the past from ignoring the psychological factor, although I should be very reluctant to subscribe to the view that the disease is purely psychopathic. Important as it is to bear in mind the doctrine of multiple factors in general medicine, it must never be forgotten in mental hygiene. We are too apt to say of a patient suffering from a psychosis: "What can you expect? Look at his family history." Granted that the inherent factor has been predominant, is it not possible that a far-seeing mental hygiene might have so dealt with other factors that a serious disorder could have been averted? It is impossible not to sympathize with those who hold that psychotherapy plays only an unimportant part in the treatment of a full-grown psychosis, but this attitude is very different from believing that it cannot be useful as a preventive measure at a more embryonic stage. Endeavour to imagine the terror which must be constantly present in the minds of many sane persons who are members of a mentally unstable family. Is it difficult to realize what comfort they would derive from a belief that heritage is not the only factor to be reckoned with, and that medical learning was capable of recognizing and assessing the other factors, so that the long-dreaded calamity might be avoided? I have a shrewd suspicion that the advice in such cases to avoid over-strain and to keep the body healthy does not quite meet all requirements. Are there not unavoidable difficulties to be faced in everyone's life, and are we not already in a position to advise how they may best be dealt with?

VALUE OF REST AND THOUGHT.

Before leaving the professional aspects of mental hygiene, and lest I should be accused of a marked bias in favour of modern psychotherapy in the prevention and treatment of mental disorders, let me say a word on the question of rest. There is no doubt in my mind that the invaders of our borderland have unduly minimized the importance of rest as a physiological essential in the prevention and cure of the psychoneuroses. Rest and sleep must, to the end of the chapter, be necessary in treating a condition of exhaustion, however the latter is produced. It is contended that with simple fatigue, uncomplicated by an anxiety state, sleep is undisturbed and refreshing. But it must be remembered that fatigue of itself may convert potential anxieties into active anxieties by reason of that loss of sense of perspective and of proportion by which it is almost invariably accompanied. In this way insomnia and disturbed sleep are brought about and a vicious circle established. This is a matter of everyday experience, and one which must not be lost sight of in any system of mental hygiene.

There is another aspect of mental hygiene on which I would like to touch, but which should perhaps be addressed to educational authorities rather than to yourselves. The chief function of the mind is thinking, and it is doubtful whether an organ can retain its maximal health if its function is not adequately exercised. But exercise must be guided and trained, especially in the young, if it is to attain its object. A game of cricket in which the participants are ignorant of the rules and uninspired by any keenness is worse, as an educational exercise, than no game at all. Is thinking a function which needs no practice, no training? Hughlings Jackson, whose contributions to psychopathology, in advance of his time like most of his work, have been revived and admirably presented to us by Dr. Maurice Nicoll, in a recent article on "Regression," was in the habit of exhorting his house physicians to set aside some portion of the day or night to thinking. He advised us to choose some question which had been raised in the course of the day, to allow our powers of association to assert themselves, and to jot down the resulting ideas in a note-book. In other words, he stimulated us to look at each question from many points of view, and to give it as many and as various attachments as possible. The value of forming such a habit can hardly be denied, and its more general adoption might prove to be a powerful preservative of mental health. This memory has been revived by references in recent literature to the beneficial results attributed to conversational re-education. It is contended that this form of psychotherapy relieves a patient's mental suffering by introducing to him other aspects of a conflict which have hitherto escaped his notice. The same principle is concerned in the commonplace experience of talking our troubles over with a sympathetic friend who, without adding to our knowledge, reveals them in different lights. If this hypothesis can be supported, is it not to be inferred that the ability to look at difficulties from many points of view is an asset of some value in the maintenance of mental health? Is it not equally justifiable to assume that this ability must to a large extent be a matter of training in our earlier days?

My recollection of school days may not be reliable, but this principle, if my memory serves me right, did not govern our education. We had little time allowed for thinking, no instruction in thinking, and no encouragement to cultivate the art for ourselves. There was an atmosphere of rigidity in regard to what might be controversial subjects in unfettered minds and a thing either was or was not the right thing to do. I can well remember the surprise experienced on leaving school in relation to matters of conduct and to opinions about individuals. The atmosphere had changed and questions previously regarded as finally settled were found to be worthy of discussion. Individuals were no longer pigeon-holed in this or that category; some with a wholly undesirable reputation had reluctantly to be conceded one or more good qualities. It may be that the somewhat narrow attitude of mind engendered by school life was adequately corrected by subsequent influences, but it is hard to believe there is no room for more systematized education in wide thinking at that period of life when the mind is most impressionable and most ready to form habits of permanent value. According to our newspapers the education of the working-class children has again this narrow outlook with a socialistic bias, and is indifferent to other points of view. This being so, it should not cause surprise if they experience mental and other conflicts in later life. This is not altogether a frivolous utterance on my part. It can hardly be disputed that a large factor in present-day social unrest is of psychological origin, and that broader education on the lines I have just indicated would not only serve mental but social hygiene.

SUMMARY AND CONCLUSION.

There are other aspects of mental hygiene concerned with schools and education, especially in relation to hours of sleep and work, but these have received attention elsewhere, and I will not detain you with them now. Having trespassed on territory where I have no authority I will be content with the inroad I have made and retrace my steps. To recapitulate, mental hygiene is a young plant worth cultivating and full of promise. Its growth must be promoted: (1) By no longer misnaming mental disorders as nervous. It is perhaps time to be courageous and to call institutions hospitals or clinics for minor mental disorders in preference to functional nervous disorders; (2) by getting rid of the confusion between ethical and medical principles as they affect health; (3) by teaching elementary principles of psychopathology and psychotherapy to students in order that the general practitioner may take a prominent part in maintaining the mental health of individuals; these subjects, being more important than much that the student is called upon to know, should be introduced into the syllabus for examinations and questions set upon them; (4) by obtaining general recognition for the multiplicity of factors concerned in producing mental as well as other disorders; (5) by giving due prominence to fatigue as a factor in psychopathology and to rest in psychotherapy; (6) by encouraging education in thinking as an important preventive measure.

I am conscious that I have displayed my admiration for, and belief in, much of the newer psychotherapy, but I am not really unmindful of what has gone before. The present condition of psychiatry and of mental hygiene—immature as it is, but full of promise for the future—could not have been reached without the mass of invaluable research undertaken and carried out in the past by many great workers in this department of medicine. If a flood of light has been thrown on the results of their labours by a later generation let us bear witness to the fact that it only adds a brighter lustre to their names.

Section of Psychiatry.

President—Dr. E. FARQUHAR BUZZARD.

Moral Imbecility.[1]

By A. F. TREDGOLD, M.D., F.R.S.Ed.

I BRING this subject before you for two reasons. First, the condition is one of the four statutory classes of mental deficiency; and mental deficiency, in spite of its great medical and social importance, has hitherto received so little attention at meetings of this and kindred societies that it is incumbent upon those of us practising in this special department to attempt to remedy the defect. Secondly, moral imbecility is a condition of extreme importance in its own right. It is one which results in serious misconduct; it is one which presents great diagnostic difficulty; and it is one regarding the very nature of which there is great misconception, confusion, and divergence of opinion. For all these reasons it is a subject eminently suitable for, and indeed in great need of, careful discussion.

The Mental Deficiency Act of 1913 defines moral imbeciles as "persons who from an early age display some permanent mental defect, coupled with strong vicious or criminal propensities, on which punishment has had little or no deterrent effect."

Since this is a statutory definition, it must form the basis of our discussion, and our best method will be to consider these terms seriatim.

I will first deal with the term "permanent mental defect," which is undoubtedly the one presenting the greatest difficulty. As you know, whilst many mental defectives, in spite of their defect, are quite well-conducted, law-abiding members of the community, there are others who are the reverse. They are, in fact, possessed of strong vicious or criminal propensities on which punishment has practically no deterrent effect: in other words, they conform to the statutory definition of moral imbeciles. It is often assumed, therefore, that this is the class to which the definition refers, that is, ordinary mental defectives possessed of vicious propensities. But if this were the case there would not have been the slightest need to draft a new definition and make another class, for such persons could readily be certified as imbeciles or feeble-minded. The fact that it was considered necessary clearly shows that it was intended to legislate for a different type of case, that is, for persons who would not ordinarily be regarded as defective; this was clearly pointed out by the late Dr. Mercier, who was largely responsible for framing the definition. What, then, is the kind of mental defect referred to in the definition of moral imbeciles, and how does it differ from the mental defect of the other three classes defined by the Act? At the outset it is important to note that the definition does not say "intellectual" but "mental" defect, for there is a great difference between these terms. A mental defect is clearly a defect in any of the complex faculties which go to the make-up of mind, whilst an intellectual defect concerns only particular faculties of mind.

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[1] At a meeting of the Section, held December 14, 1920.

In order to understand the nature of the defect in moral imbeciles it is necessary to make a short digression, and to consider what are the mental factors concerned in conduct. It is now generally recognized that the mainspring of most, if not all, human conduct is to be found in certain instincts or impulses. Many of these date from very early human, or even from prehuman times, and are therefore deeply ingrained. The instincts which have been described are numerous, and although it is probable that most, if not all, are modifications of a single primary one, namely, that directed towards the perpetuation of the species, it is convenient to differentiate, and we may, for our present purpose, make a brief allusion to four—namely, the sexual, combative, acquisitive and self-displaying.

Originally these instincts were no sooner aroused than immediate action followed. The sexual instinct led to rape and promiscuous sexual intercourse; the combative to assault and homicide; the acquisitive to theft and robbery; the self-displaying to boastful lying. Even to-day in many barbarous races we find these primitive instincts still manifesting themselves in their original primitive way, that is, in immediate action regardless of any secondary considerations. In the untutored child born in a civilized community we still find them tending to the same immediate expression.

Now if we imagine man as he existed at a very early stage of social evolution, we shall admit that a time would very soon come when such unrestrained response to these instincts would bring him into conflict with superior force and lead to painful reprisals. The community, whether it consisted of an enlarged family connected by blood ties, or of an assemblage of such families, would realize that certain acts were inimical to its safety and well-being; consequently such acts could not be tolerated, and stringent rules would be made prohibiting them. The individual would speedily realize that not merely his personal comfort, but even his life, might be dependent upon the observance of these laws, and such intellectual perception would act as a restraint upon his instinctive tendencies. The gradual evolution of society would tend to increase these prohibitions and to impose more and more restrictions upon instinctive conduct, with the result that conduct would become more deliberate and less impulsive.

It is clear that the quality of mind which is necessary to enable the individual to survive as society evolves embraces much more than the mere intelligence needed to adapt acts to the requirements of the moment. It necessitates an ability to visualize the consequences of an act before that act is committed, to project the act mentally into the future, to compare such projection with the law and codes laid down by society, and to restrain the act in accordance with the judgment thus formed. In short, since on the whole, success in life is dependent upon ability to conform to the requirements of society, the individual who would succeed must be able to look beyond the needs of the day and to make plans for the future, to map a course as well as to steer one, to forgo present gratification for the sake of future advantage, and so to co-ordinate his conduct that if he does not actually achieve success at all events he deserves to do so. Further, the individual must be able to bring these qualities of foresight, judgment, and control to bear upon his conduct amid the exigencies of life and often under the influence of profound emotion.

No doubt the psychological processes which make up this higher mental level are very complex. It is, however, convenient to speak of them as if they were a single faculty, and to this mental quality we may give the term "wisdom." Dr. Mercier defined wisdom as "that intellectual quality that guides and governs the higher and more comprehensive phases of conduct, that regulates the main business of life in adaptation to circumstances, that teaches us how to act, so that in the long run and on balance our lives will be successful." I may remark that since wisdom would possess a very great survival value, it would tend to be perpetuated, whilst those individuals in whom it was lacking would tend to be eliminated.

It is now necessary to allude to another attribute of mind which plays a great part in the regulation of conduct—namely, what is known as moral, or perhaps better, social sense. Moral sense is sometimes termed "conscience," and it is often assumed that this is an innate faculty, a still small voice, which provides its possessor with an infallible guide as to what is right and wrong. I need hardly say that this view is incorrect; the time at my disposal, however, will only enable me to give the briefest sketch of its psychological nature and evolution. The normal human mind is very acutely sensitive to the approbation and disapprobation of public opinion. To a certain extent this perception is an intellectual one, based upon the fear of consequences, but it also seems to have an emotional basis, being closely related to those self-regarding sentiments of the individual which we speak of as self-respect. When primitive man had arrived at the stage of regulating his conduct through wisdom, that is through the intellectual perception that it was wise to do so, the approbation following such restraint would favour the evolution of his self-respect, and there would gradually be developed a sentiment regarding such acts. Conduct in accordance with the customs of the community would come to be regarded not only as wise but as right; conduct opposed to those customs as not only unwise but wrong. Such a sentiment in course of time would be extended to all new laws and customs which were supported by public opinion, or which were enunciated by individuals whose character or station made an appeal to the imagination or respect of the populace, with the result that ideals of conduct would gradually be developed which would not only act as a restraint to primitive instincts, but would possess an actual impelling force of their own.

There can be little doubt that such moral or social sentiment lies at the root of our more advanced Western civilization. Based primarily upon the desire for approbation, self-esteem, and the tender emotions, as we see it to-day it is the quality of mind which enables man to feel that he has obligations to society, which makes him sensible of the ideals of honour and honesty, of compassion and chivalry, of patriotism and altruism, and which not only restrains the individual from doing wrong, but impels him to do right.

It has thus come about that although instincts still form the mainspring of human conduct, impelling man to definite ends which are favourable to the perpetuation of the race, the mode by which these ends are now attained, the manner in which these instincts are manifested, has undergone a great modification. Amongst civilized peoples the sexual instinct is no longer manifested in rape and promiscuous intercourse, but within the bonds of wedlock. The combative instinct no longer finds expression in assault and slaying of our opponent, but in forbearance, or if this is impossible, in legal process. The acquisitive instinct, whilst still operative, is restrained within the law of the land: and the self-displaying instinct within the canons sanctioned by good taste. In short, we may say that although instinct still directs to the same terminus, wisdom and moral sense have resulted in a considerable variation in the mode of conveyance and route followed. Conformity to the regulations as to conveyance and route prescribed by society constitutes correct social conduct; non-conformity to these regulations constitutes misconduct.

Such, briefly stated, is the manner in which the regulation of conduct was gradually evolved in the race. A very similar process takes place in the development of the individual. The new-born child has neither wisdom nor moral sense; he has, however, many deeply ingrained impulses to action, and in his early years these tend to be expressed in their original primitive way. This is so far recognized by the law of England that a child under the age of 7 is deemed incapable of committing a crime. In the normal child, as a result of precept, example, admonition and punishment, there is first gradually evolved the intellectual perception that misconduct does not pay. At a somewhat later age the development of moral sense becomes superadded, the child acquires a sentiment of his relationship to society, of social obligation; and later of still higher moral and social ideals.

In some instances misconduct would appear to be the result of very pronounced or even abnormal impulses; speaking generally however, misconduct is probably due to a defect of the qualities we have mentioned—namely, wisdom and moral sense. Of these two, defect of wisdom seems to me the more important. There are many people with a decidedly weak moral sense, and although this may result in occasional criminal acts, it does not in itself lead to persistent misconduct, because, wisdom being present, they are able to realize the personal disadvantage of such misconduct. If however a person is deficient in wisdom as well, that is, if in addition to an inability to appreciate ideals and the rightness or wrongness of acts, he is unable to learn from experience and to realize that the commission of vicious and criminal acts is to his disadvantage, then he will be deprived of all restraining influence, he will be incapable of conforming to the standard set up by society, and he will be a persistent and incorrigible criminal.

It is evident that these two mental qualities stand on a higher developmental plane than does ordinary intelligence. As a result of ordinary intelligence a person may be able to acquire scholastic information, he may possess a good range of knowledge, may be quick at repartee, full of wit and a brilliant conversationalist; he may be able to regulate his acts in accordance with the requirements of the moment, and even to do so with considerable cunning and skill; but he may still be lacking in any sense of the rightness or wrongness of those acts, he may be incapable of forming a judgment as to their ultimate effect, and unable to co-ordinate his conduct to his ultimate advantage. Such defect is truly mental, and I am of the opinion that it is the defect meant in the definition of a moral imbecile.

There can be no doubt that persons thus defective require care, supervision and control for their own protection or for the protection of others, and that consequently they conform to the statutory definition of feeble-minded persons. Strictly speaking therefore moral imbeciles could be certified as feeble-minded, but the idea is so prevalent that feeble-mindedness connotes a fairly obvious defect of intelligence, that in actual practice certification under this definition is usually impossible; it was owing to this restricted and erroneous conception that a new definition was rendered necessary.

The definition says that the mental defect must be *permanent*, and we have now to consider this. This word has given rise to considerable difficulty and its omission has even been suggested. I think, however, that it is really necessary to define the class. As I need hardly point out, the higher mental qualities of wisdom and moral sense are not innate, they are largely dependent upon training. The child who is brought up in an atmosphere of vice and selfishness is not likely to develop any ideals of social obligation or of the rights of anyone but himself; similarly the child who is never punished or in any way made to experience the consequences of his acts, whose whole surroundings are those of thriftless improvidence, and of complete disregard for the future, is little likely to acquire much wisdom. No doubt in many children such defect of training lies at the root of vicious and even criminal conduct. Further, even where the environment is satisfactory, there are some children who are late in developing these higher qualities, just as some children are late in developing somatic functions. Until these controlling qualities of mind have been evolved the child's behaviour necessarily remains self-seeking and anti-social. On the other hand there are certain cases in which, in spite of the most careful training and the due lapse of time, these qualities never appear. Such children are innately lacking in the potentiality for the development of these faculties, and this lack is permanent. These are the true moral imbeciles and it was to differentiate this innate defect of potentiality from defect due to delay or to faulty training and environment that the word permanent was used.

The next term of the definition, namely, *strong vicious or criminal propensities*, does not usually give rise to much practical difficulty. Obviously, we have no means of judging what propensities exist until they have become manifest as conduct, so that to establish the presence of strong propensities we must have evidence of the repeated commission of vicious or criminal acts. Such evidence is usually abundant, indeed it is because of it that the suspicion of moral imbecility is raised, and the only difficulty which is likely to arise in a particular case is whether the misconduct committed comes within the statutory definition. In the case of criminal offences there can rarely be any difficulty, for this term has a tolerably well recognized meaning; the term "vice," however, is an exceedingly elastic one and calls for a few remarks. Misconduct in the sexual sphere is that which is likely to cause the chief trouble, and in actual practice the question resolves itself into this: Can the amateur or professional prostitute be said to evince such strong vicious propensities as to come within this term of the definition? My own view is that prostitution in itself does not amount to the viciousness intended, and that the criterion must be, not the actual sexual immorality, but the attendant circumstances. Thus, in the case of a woman pursuing her calling in what may be termed a decent, respectable manner, I should say the offence was not vicious within the meaning of the act. On the other hand, in the case of one openly and persistently flaunting herself in an offensive and outrageous manner, or of one guilty of the indiscriminate spreading of disease to all and sundry, I should say that it did amount to such vicious conduct.

It must be remembered, however, that vicious conduct must be coupled with permanent mental defect to bring the individual within the statutory definition of a moral imbecile, and, as a matter of fact, it is usually only where there is such defect, that viciousness, as above described, will be found; since the non-defective woman has the wit to see that it does not pay flagrantly to violate the law and outrage public decency or to spread disease.

The next term to be considered is *from an early age*. These words are admittedly very indefinite, and they have consequently been interpreted very differently. Some persons would take them to mean infancy or childhood; on the other hand the age of 17 has been accepted by the Courts as complying with the definition. I am of the opinion that their real purpose is to differentiate between a mental defect which is innate and one which is acquired subsequently to normal development, and consequently by "an early age" is meant the age at which conduct usually begins to show itself. In most instances defective regulation of conduct will be apparent during the years of childhood, and as a matter of fact in most moral imbeciles there is a history of intractability, defiance of authority and acts of misconduct dating from the first decade of life. It is to be remarked, however, that many instincts may not attain their full evolution until considerably later than this, and that the full regulation of conduct may not become necessary until the individual gets away from the restraint of home and is called upon to face the world more or less on his own responsibility; a defect which up to that time has been latent may then become patent. For this reason I think that we are justified in regarding the period of adolescence as constituting "an early age," and as a matter of fact in quite a considerable proportion of cases which I regard as true moral imbecility it is not until after the age of 12 that any serious misconduct begins to show itself.

The last term of the definition is *on which punishment has had little or no deterrent effect*. The question arising here is the meaning of the word punishment. Must it be punishment inflicted by the law, or will that administered in the orthodox way by a parent or guardian suffice? There are some who contend that it must be legal punishment, and that a person cannot be brought within the definition of a moral imbecile unless he has been sentenced by the Court. I think this view is wrong. It seems to me that the object of introducing this qualification is to differentiate the normal from the abnormal, and to make it additionally clear that the class to whom the term "moral imbecile" is applied is that in whom misconduct is due to mental defect. The fact of misconduct being or not being deterred by punishment does form a very important criterion by which we may distinguish the normal from the abnormal. For in the non-defective person punishment, provided it is adequate to the offence, will suffice to convince the offender that misconduct does not pay, and he will therefore realize that it is against his interest to repeat it. The moral imbecile, on the other hand, is lacking in the wisdom to appreciate this, with the result that for him punishment has little or no deterrent effect. I hold therefore, that the infliction of such punishment as would suffice to deter the ordinary normal child from a repetition of the offence would be quite adequate and would fulfil this term of the definition. In the normal child it is rare for more than parental punishment to be required to do this. It is thus clear that this term of definition is much more than a legal technicality which must be complied with; it is a touchstone of great importance, which must always be applied before we can diagnose moral imbecility. I mention this because I have seen persons who, owing to repeated offences, had been thought to be moral imbeciles; but they were the spoilt darlings of doting parents, and they had never been adequately punished. Consequently, not only had they not suffered any ill-effects or even inconvenience from their misconduct, but they had actually derived advantage therefrom, so much so that non-persistence would have been more indicative of lack of wisdom than persistence. The infliction of a punishment to fit the crime, and the enforcement of a rigorous discipline led eventually to a complete alteration in their behaviour.

We see then that although the statutory definition is made up of several distinct terms, these are nevertheless largely complementary to one another, and taken as a whole they define the moral imbecile with considerable accuracy.

DESCRIPTION.

Physically, moral imbeciles are usually well-developed and present none of the signs so commonly seen in ordinary aments. Most of them are quite pleasant looking persons, indeed not a few are unusually engaging and attractive. Similarly with regard to their intellectual attainments and ordinary intelligence, moral imbeciles present no distinguishing features. They will converse well and even brilliantly upon the ordinary topics of the day, whilst many of them are so plausible in their speech and so apt at repartee as to appear exceptionally clever and astute. Although their whole conduct and the application of special mental tests reveal defect of judgment and wisdom, the physician who attempts to arrive at a diagnosis by means of the ordinary tests of scholastic proficiency will assuredly fail, whilst the person who trusts to physiognomical expression will have a rude awakening when he learns the history of their misdeeds. It would serve no purpose to describe the crimes they may commit, which range from petty pilfering to homicide. The commonest are theft, embezzlement, the passing of worthless cheques, the obtaining of goods by false pretences or other forms of fraud, incorrigible lying, sexual offences and assaults. I do not think I have ever known a moral imbecile who was not a confirmed liar, and not infrequently one meets with that artistic form of lying known as "pseudologia phantastica." With regard to their crimes it is worthy of note that in spite of their cunning in making elaborate plans, they will often neglect some simple precaution which could hardly be omitted by a person of average common sense, and this omission leads to their speedy detection. As Mercier said, "they are merely clever fools." Speaking generally, we may say that they are characterized by complete selfishness, want of affection, and an utter disregard of the rights or feelings of other people; a lack of any real shame or remorse for the acts committed, even when these are of the most brutal and fiendish nature; an intolerance of discipline and authority; a complete disregard of public opinion and an incapacity to appreciate any such ideals as honour and honesty, justice and probity, social and patriotic obligation, a want of the sense of responsibility, and an utter incapacity to profit by experience.

DIFFERENTIAL DIAGNOSIS.

Although the class with which we are dealing has been defined by statute for the past seven years, experience shows that there is still great misconception and ignorance regarding it. There are judges, magistrates, and even medical men who appear to think that mind embraces nothing higher than the ordinary common intelligence by virtue of which an individual is enabled to adapt his acts to the requirements of the moment. If he can do this, and if he has a fair scholastic knowledge and can converse intelligently, he cannot possibly, according to them, be defective. I have frequently heard the remark passed, regarding a person whose life history was a record of continuous crime, and about whose defect I had not the slightest doubt, "How can he be defective, he's as 'cute as a needle?" Persons of this kind entirely fail to recognize the very existence of moral imbecility, and I think that public officials who cannot do this after the lapse of seven years should be superannuated. On the other hand, there are persons who appear to think that every individual who is guilty of repeated misconduct must of necessity be a moral imbecile, and this view is hardly any less pernicious than the former one; for it not only tends to abuse of the Act, but may inflict serious harm upon those whose condition is thus wrongly diagnosed.

Diagnosis is admittedly a matter of very considerable difficulty, although if we take care to see that each term in the statutory definition is fulfilled this difficulty will be much lessened; it may however be useful to enumerate briefly the conditions which more or less simulate moral imbecility and from which it has to be distinguished.

The first of these is ordinary delinquency. There is no doubt that persons exist whose moral sense is weak, but who nevertheless know that certain acts are wrong; they are also fully aware that if they commit these acts and are found out they will suffer. The chance of detection, however, may seem so small and the advantage resulting from the act so considerable, that they deliberately take the risk. This is ordinary delinquency, and it differs from moral imbecility in that the misconduct is not persistent and continuous, but occasional only. In the class known as instinctive or habitual criminals, in which misconduct is persistent, so that the individual shows an utter incapacity to run straight, and is no sooner liberated from imprisonment than he is engaged in fresh depredations, there is *prima facie* evidence of defective judgment, and as a matter of fact most of such instinctive criminals, if not all, are in reality moral imbeciles.

The second class of case is that in which *the development of the controlling faculties is delayed.* This may occur under two conditions, one of which is intrinsic and the other extrinsic: I will allude to these separately.

As I have already mentioned, the qualities of wisdom and moral sense represent the latest achievements in the mental evolution of the race, and they are similarly the latest to appear in the evolution of the individual. No doubt individual differences in this respect are dependent upon race, social class and family antecedents, and whilst most children have evolved sufficiently to regulate conduct by the end of the first decade, cases occur in which this does not happen until the later years of adolescence. Until this time the person's behaviour will necessarily tend to be unregulated, selfish, and anti-social, and the condition may well be thought to be one of moral imbecility. In most cases a close inquiry into the behaviour will show that although such persons are selfish and prone to miscoduct, this misconduct is neither so persistent nor so outrageous as in the moral imbecile; nevertheless the resemblance may be sufficiently close to make diagnosis impossible for a time. Time is the only real test, and in view of the possibility of this condition, the greatest care should be taken in certifying under the Act until the later years of adolescence have been reached.

A similar condition of delay may result from defective training or a vicious and criminal environment. Many minor examples of this kind, in the shape of juvenile hooligans, were seen during the war, and they were generally attributed to the absence of discipline owing to the father being away. More marked instances came from the slums and the nomadic population. If such persons can be removed from their adverse surroundings sufficiently early and be placed under firm discipline and good moral influence, there is a probability that they may acquire control and become law-abiding citizens, as is shown by the record of such philanthropic institutions as the Church Army and Dr. Barnardo's Homes.

The third class of case is that in which misconduct is due to *acquired mental disorder.* Cases of this kind are very frequent, and it is particularly necessary to bear them in mind when confronted with a supposed moral imbecile. The mental disorder may range from a temporary, and comparatively slight, disturbance of equilibrium to one which is severe and incurable, but whilst it lasts misconduct may be very marked. For instance, such lapses are by no means rare in neurotic youths and girls after exhausting illnesses, or even during the physiological epochs of puberty and adolescence without any definite illness. They may also occur in consequence of a repressed complex following some psychic shock or emotional experience; or from a condition of conscious mental agitation due to the individual being in a state of disharmony with his environment, such for instance as having been put to an occupation which is thoroughly distasteful to him. When more pronounced, these conditions constitute adolescent insanity. I regret that the time available does not allow me to do more than merely mention these conditions, particularly because I am convinced that adolescent instability and adolescent insanity are very prevalent and important causes of misconduct, and that persons suffering from them are frequently thought to be moral imbeciles. Such an error would usually be prevented by a careful study of the personal history.

Another condition to which I may refer is that of brain injury. During the recent war, in a very large number of soldiers the brain was injured by a severe gunshot or other wound. Of those who survived a small proportion developed some form of psychosis, and in a small percentage of these it took the form of a complete alteration of the moral character. Young men who had previously been steady, honest, industrious, sober, and in every way perfectly well conducted, became exactly the reverse. They became careless and indifferent to the customary routine, disrespectful and defiant to those in authority, lazy, drunken, addicted to lying, theft and other offences. There was, in fact, such a complete alteration in their whole disposition and behaviour as to call forth remark from all those who had known them before the injury. In every respect their conduct resembled that of a moral imbecile.

Lastly, I may refer to cases of cerebral lesions due to disease. I have occasionally had sent to me a youth or girl who had been diagnosed as a moral imbecile on account of persistent lying, thieving, and a marked alteration of conduct and disposition. Careful examination revealed the physical signs of early general paralysis.

In conclusion, let me say that no one can be more conscious than I am of the incomplete manner in which I have dealt with this subject, which is one of great magnitude and importance. I trust, however, that I have said enough to form a basis for your consideration and discussion.

DISCUSSION.

Dr. **STODDART** differed from the opinion that the moral sense arose in man through the inheritance of an acquired instinct and that it was instilled anew into every child by education. Rather would he regard the moral sense as being an innate instinct developed in a gregarious animal through natural selection by the survival of the fittest. Cases of moral imbecility were either individuals otherwise normal who never developed a moral sense, habitual criminals for whom no treatment was of any avail, and a third class of patients who began to commit immoral acts as soon as puberty was reached. This last class required special recognition because their moral defect was not permanent and could be cured by psycho-analysis. Such patients revealed complexes of various kinds, for instance, a desire for power which was felt to be lacking and which was gratified by stealing objects symbolizing power, or by boastful lying. Intellectually such patients were perfectly normal and being curable should not be treated under the Mental Deficiency Act.

Dr. **Shrubsall** agreed that the basis of moral deficiency was a failure of development in the individual of altruistic master sentiments whether from undue strength of the egoistic or sex instincts or from weakness of the herd instinct perhaps coupled with a bad environment in the plastic period of life. The actual definition showed the disadvantages of hard-and-fast legal definitions in clinical matters, and difficulties arose with regard to each term. Some would require evidence of defective conduct to be shown from early infancy, others would be satisfied with evidence dating from adolescence. The word "permanent" introduced complications of another kind; if there was any truth in the statements that by means of psychotherapy, whether in the form of psycho-analysis, or otherwise, hidden springs of trouble might be tapped and the psychic energy released to more normal routes of operation, the defect in such cases could not be regarded as permanent. Who was prepared to say with the brief opportunities for diagnosis available to most certifying officers which cases could be relieved and which could not? It was unnecessary to be required to make so detailed a prognosis. Surely it was sufficient to show there was some mental defect and that because of this the subject needed care and control for his own protection or the protection of others. Then with regard to the terms "vicious" and "criminal propensities" circumstances altered cases and the subject might reasonably often deem he had made a good bargain in sacrificing a hypothetical future for an immediate desire. If the circumstances were such that the sacrifice was manifestly absurd the subject could without difficulty be termed feeble-minded. Punishment was another stumbling block in the path. What a certifying officer, teacher, magistrate or parent might think was punishment, and so a prospective deterrent, might appear in a quite different light to the subject; among some groups of boys to be punished was regarded as an honour and as admitting them to some degree of precedence in their little groups. In this case the partial herd regarding this as an honour the instinctive force would be acting not as a deterrent but as an encouragement to conduct which would be regarded as vicious by other partial herds. All these difficulties would be avoided if the Mental Deficiency Act had contained one definition only: the first half of the definition of the feeble-minded person. German law did this, saying "Those who do not possess the power of considering the results of their actions are termed imbeciles" and leaving it no more precisely defined. Such a change also got rid of the undoubted overlap between the definitions of idiot and imbecile and of imbecile and feeble-minded person. Turning to another aspect of the matter no one could rightfully give a certificate of moral imbecility unless he had acted in the spirit of the old Puritan who seeing a criminal going to execution said "there but for the grace of God goes John Bradford." It was easy for them to say that a person had views of conduct which differed from their own; it was less easy to say that they would have acted differently had they had that person's circumstances to contend with and only his upbringing behind them. The herd instinct only gave its sanction to the acts of the immediate herd so that where persons were brought up to profit by theft, was it a sign of abnormality that they should steal; if they were brought up with no privacy and in an atmosphere of loose sexual relationships was it abnormal that they should find prostitution as easy mode of life? Yet there were sheltered individuals who would call all prostitutes moral imbeciles. To be evidence of abnormal mentality the conduct complained of must have been abnormal in the surroundings of the subject. Hence it was much easier to certify as to deficiency in subjects of the educated classes. Dr. Mercier had described the moral imbecile as a clever fool; in so far as he was a fool he was certifiable as feeble-minded, but the true moral imbecile was no fool. In his own eyes and often in all appearance he was successful, he had got on by sacrificing others to himself. There were all grades of this tendency but ethically at least the line was crossed when the subject sought the immediate gratification of his own primitive instincts regardless of all consequences to any but himself however much his intelligence might enable him to keep within the four corners of the law. Such were not included even by the special definition. A second generation who had not had their wits sharpened by struggles in early life often showed the tendencies to self-seeking without the necessary intellectual balance and thus proved failures. Hence the proverb "clogs to clogs in three generations." A simplification of the definitions in any amendment of the Mental Deficiency Act would be welcome.

Section of Psychiatry.[1]

President—Dr. E. FARQUHAR BUZZARD.

The Microscopical Examination of the Choroid Plexus in General Paralysis of the Insane, and other forms of Mental Disease.

By T. MOROWOKA (Kyushu, Japan).

(Communicated by Sir FREDERICK MOTT, F.R.S.)

(ABSTRACT.)

THE following research has been carried out in the Pathological Laboratory of the London County Mental Hospitals, Maudsley Hospital, and I would express my gratitude to the London County Council for permission to work in the laboratory, to the Director, Sir Frederick W. Mott, for his unfailing interest and guidance, and to his staff for their helpful assistance.

MATERIAL.

In all, the choroid plexus from twenty-six cases has been examined; the mental classification, age at time of death, and pathological conditions found at autopsy are as follows:—

Normal Case.

No 74: J. McK., male, aged 20. Death from gunshot wound through spinal cord.

General Paralysis of the Insane—Nine Cases.

No. 18: J. N., female, aged 60. Broncho-pneumonia; fatty heart; grave anæmia.
No. 41: E. D., female, aged 49. Broncho-pneumonia; bronchitis.
No. 43: H. M., male, aged 62. Broncho-pneumonia.
No. 45: C. K., male, aged 42. Broncho-pneumonia.
No. 47: C. S., male, aged 64. Broncho-pneumonia.
No. 48: J. W., male, aged 61. Lobar pneumonia; arterio-sclerosis.
No. 56: C. J. G., male, aged 43. Early broncho-pneumonia.
No. 57: C. E. S., male, aged 40. Exhaustion of seizures.
No. 58: J. W. M., male, aged 62. Gangrene of lungs; arterio-sclerosis; renal disease.

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[1] At a meeting of the Section, held January 11, 1921.

Mania—Seven Cases.

No. 20: L. K., female, aged 60. Senile decay? arterio-sclerosis; broncho-pneumonia.

No. 21: E. M., female, aged 66. Broncho-pneumonia; arterio-sclerosis.

No. 34: H. B., male, aged 37. Pneumonia and gangrene of lungs.

No. 39: S. S., female, aged 39. Broncho-pneumonia; grave anæmia.

No. 40: A. A., female, aged 70. Pneumonia; pneumococcal meningitis.

No. 50: E. K., female, aged 25. Pulmonary tuberculosis.

No. 53: F. T., male, aged 39. Broncho-pneumonia.

Senile Dementia—Two Cases.

No, 33: F. W., female, aged 66. Pneumonia.

No. 44: W. T., male, aged 65. Pneumonia; arterio-sclerosis.

Dementia Præcox—Three Cases.

No. 1: W. H., male, aged 20. Lobar pneumonia.

No. 2: F. R., female, aged 29. Tuberculosis of lungs and intestines; chronic interstitial nephritis: waxy degeneration of liver and spleen.

No. 3: E. G., female, aged 27. Pulmonary tuberculosis.

Epileptic Insanity—Two Cases.

No. 51: M. A., female, aged 32. Congenital weak-minded epileptic; pulmonary tuberculosis; fatty liver.

No. 54: G. H. S., male, aged 37. Epileptic dementia; pleurisy and hypostatic congestion, both lungs; cardiac failure; fatty degeneration of heart.

Alcoholic Dementia—One Case.

No. 42: H. B.: female, aged 53. Arterio-sclerosis; morbus cordis.

Melancholia—One Case.

No. 52: C. B.. male, aged 50. Pulmonary tuberculosis.

Arranged in ages at time of death the numbers are as follows:—

70 years and over	1
60-69 ,, ...	9
50-59 ,, ...	2
40-49 ,, ...	4
30-39 ,, ...	5
20-29 ,, ...	5
	26

MACROSCOPICAL APPEARANCES.

Except in the cases of general paralysis and cases of advanced age there were no marked pathological changes, but the young epileptic and dementia præcox cases showed cystic growth but not denuded epithelium. In general paralysis the choroid was usually enormously fibrosed and appeared like a cord, with almost complete denudation of epithelium. There were no marked pathological changes seen in the cases of mania and melancholia except those which could be accounted for by advancing age, and even the older cases showed comparatively but little fibrous change.

STAINING METHODS.

In the majority of instances the bodies were injected through the carotid arteries with Ringer's or saline solution, the choroid plexuses preserved in 5 per cent. formalin solution, sections cut by freezing microtome method or from paraffin blocks and stained by the following methods:—

(1) Herxheimer scharlach R.—hæmatoxylin method.
(2) Lorrain Smith Nile blue method.
(3) Mann methyl blue—eosin method.
(4) Ranke Victoria blue method.
(5) Nissl methylene blue method.
(6) Nissl toluidin blue—eosin method.
(7) Unna polychrome methylene blue method.
(8) Heidenhain hæmatoxylin—eosin method.
(9) Delafield hæmatoxylin—eosin method.
(10) Weigert hæmatoxylin resorcin—fuchsin method.
(11) Unna orcein method for elastic fibres.
(12) Van Gieson picro-fuchsin—hæmatoxylin method.

The first four methods were found to give the most instructive preparations, and the remainder were used for purposes of confirmation.

The methods of Herxheimer and Lorrain Smith were of great value in demonstrating fatty and lipoid changes. By the latter method the granules of the choroid epithelial cells show central deep blue staining, the membranes of the granules purple blue, with the intermediate zone unstained or of a pale greenish colour. The cell-membranes, the nuclear membranes and myelin sheaths generally stain a purple violet tint. With the selective staining reaction of Nile blue I have been able to demonstrate the presence of lipoid of cholesterol nature and neutral fat, showing as red and purple stained large and small masses in the epithelial cells and especially in the degenerating connective tissue of the choroid plexus in dementia præcox.

In this investigation I have introduced the following modification in Mann's methyl blue—eosin method. The tissues (paraffin sections) are passed through xylol and alcohols, and placed in 0·5 per cent. acetic acid for a quarter to one hour. After thorough washing in tap-water, they are stained for twenty-four to forty-eight hours at room temperature with Mann's original methyl blue eosin solution. The tissues are now tap-water-differentiated, with frequent changes, until a colour cloud no longer appears. They are now developed with 0·5 per cent. acetic acid solution for one hour; the normal tissue appears pale blue whereas the eosinophil substance stains bright red, and the contrast is excellent. After thorough washing with distilled water, they are passed through aniline oil—alcohol mixture, originum oil, benzene, and mounted in benzol-resin. The use of this modification obviates fixation with solutions of heavy metals, and by the use of the aniline-oil mixture, the troublesome and uncertain differentiation with alkali and acid is no longer necessary. The sections are lighter and more transparent; and the pure navy blue and bright red stains afford an excellent contrast in pathological cases.

THE NORMAL CHOROID PLEXUS—CASE 74 (AGED 20).

The granules, cytoplasmic membranes, and nuclei of the epithelial cells are well shown by such basophil stains as Nissl methylene blue, toluidin blue, Unna's polychrome and hæmatoxylin, and are not stained by acidophil stains such as eosin, acid fuchsin, resorcin and orcein.

By Mann's methyl blue eosin method the epithelial cells, together with the endothelium and connective tissue stroma, are stained pure navy blue without the slightest trace of eosinophil reaction. Victoria blue (Ranke method) stains morbid sclerotic tissue of the choroid plexus a characteristic violet; the nuclear and cellular membranes as well as the granules of the normal plexus cells, together with the endothelium and connective tissue stroma take a very poor and faint violet stain. With the Herxheimer scharlach R. method, the lipoid granules of the epithelial cells appear orange coloured and the endothelium and connective tissue stroma show no marked coloration. In this case there was no evidence of hyaline concentric degeneration, cystic metamorphosis or calcareous concretions.

PATHOLOGICAL CHANGES.

The morbid changes observed in the choroid plexus in the twenty-six cases examined may be divided into the following stages:—

(*a*) Hypersecretion phenomena of epithelial cells, epithelial cell proliferation and formation of pseudo-colloid cysts. The hypersecretion phenomena are evidenced by distension of cells and nuclei, and swollen and distended tubules, especially in the central parts, and the presence of lipoid and chromatin granules, with usually some degree of epithelial cell proliferation of smaller cells with larger distorted nuclei. This has been shown experimentally by Pettit and many others.

(*b*) Acidophil staining of the epithelial cells and fibrous stroma.

(*c*) Fibrous tissue proliferation and cystic degeneration. Accumulation of cholesterol in the epithelial cells and fibrous stroma. Concentric bodies of a steatotic nature.

(*d*) Calcareous degeneration.

(*e*) Extensive epithelial cell destruction, denudation of the choroid plexus, and necrosis of the fibrous stroma.

All these morbid changes are seen to a marked degree in general paralysis of the insane. In this disease and also in the cases of senile dementia examined the choroid plexus showed a remarkable diminution of chromatin substance of both basophil and oxyphil character, also of lipoid granules. Moreover, and especially in the later stages of these diseases, the plexus was very poor in villosity, with more or less completely denuded epithelium, and with considerable hypertrophy of the connective tissue and endothelial components: showing various forms of morbid metamorphosis—connective tissue hypertrophy and endothelial degeneration of the villi; amyloid, calcareous and lipoid metamorphosis of both larger vessels and villi of the choroid plexus. In addition, in these diseases, there is the presence of lipochrome granules in the epithelial cells. In the earlier stages of general paralysis and the few instances of later stages where the epithelial cells still remained, these epithelial cells showed indications of marked hyperactivity.

In the single case of alcoholic dementia examined there were no marked morbid changes observed except general shrinkage of the choroid tissue and a remarkable diminution, almost exhaustion, of chromatin substance and lipoid matter. These changes are of interest in view of the fact that alcohol can pass into the cerebro-spinal fluid, but as only one case has been examined, no definite conclusions respecting characteristic changes in alcoholic cases can be drawn.

The six cases of mania and melancholia examined showed the existence of well-surviving and actively functioning epithelial cells, in which were observed indications of hypersecretion, eosinophil staining of the nuclei and cytoplasm, and further, some degree of fibrous metamorphosis. These changes occurred in all cases, both young and old, showing that advancing age is not the sole cause of degeneration of the epithelium, vascular endothelium and connective tissue of the choroid plexus.

In the case of the two comparatively young epileptics the villosity of the choroid plexus was well-developed, but some villi showed proliferation of the epithelium and hypertrophy of the endothelium and connective tissue stroma. The epithelium and, even more so, the connective tissue stroma and vascular endothelium showed marked lipoid degeneration, hyaline concentric lipoid metamorphosis and calcareous degeneration. The occurrence of calcareous deposits in a comparatively young case of epilepsy is of considerable interest. While the hypertrophied endothelial cells showed marked eosinophil reaction the epithelial cells showed scarcely any eosinophil granules.

The three cases of dementia præcox examined did not show such marked changes as those met with in general paralysis and other cases. The epithelium was well preserved. The cells were rather smaller and longer than normal and showed a diminution of basophil chromatin matter with a correspondingly increased acidophil reaction. The epithelial cells showed more granular chromatin substance, especially of cholesterol character, and fat droplets. The connective tissue stroma and endothelium show a moderate proliferative fibrous degeneration around the large vessels and villi of the choroid plexus. They show also hyaline and concentric amyloid bodies.

Even the surfaces of large cystic formations met with in these cases are usually covered with flourishing epithelial cells, while the stroma shows an embryonic mucoid metamorphosis of the connective tissue cells and fibres accompanied with forms of fat degeneration. The cells of the stroma are especially abundant in lipoid of cholesterol nature and often neutral fat.

The cerebro-spinal fluid has been regarded as the essential fluid for the central nervous system from both mechanical (Majendie) and chemical points of view (Mott and others); in chemical properties it contains suitable nourishing media—sugar, a trace of protein matter, and inorganic salts.

In the infant the choroid gland possibly serves for myelinization, as its development always precedes cerebral growth, and in fœtal life the choroid is very rich in fat and glycogen (Luschka, Kollmann, Goldmann, Pellizzi and Monakow). I have found this also in the choroid of the new-born child. Its material is supplied probably from other endocrine organs. The choroid gland may be regarded as the main producer and regulator of the normal cerebro-spinal fluid. It is the filter of toxic products and probably absorbs and passes into the blood the katabolic waste products of the nervous system (fatty acids, especially unsaturated types mixed with cholesterol, and similar substances which have a great capacity for oxygen). These products are absorbed and presumably by their direct action of stimulation on the choroidal epithelial cells induce the further secretion of fluid to dilute and neutralize abnormal conditions of it. This is supported by the fact that a solution containing extract of choroidal epithelium obtained from Sir Frederick Mott was found by Halliburton and Dixon to induce increased secretion of cerebro-spinal fluid when injected intravenously into animals. Halliburton and Dixon have also shown that the injection of drugs, &c., that increase the general CO_2 tension increases the flow of cerebro-spinal fluid.

In the abnormal conditions I have investigated the first morbid process occurring could be demonstrated histologically as indicative of hypersecretion of the epithelial cells followed by eosinophil and fuchsinophil staining reactions indicating a general acidity of the choroid tissue.

In the non-mental case this eosinophil reaction was not observed, and in some of the other cases examined, with respiratory insufficiency resulting in death from pneumonia, &c., it was not present to any great extent. These facts suggest that the acidophil reactions presented by some of the mental cases are not the result of post-mortem change, also that they cannot have been caused altogether by intercurrent disease causing death, and that they are the result of a condition of chronic acidity arising from cerebral physiological disturbance, probably autotoxic in origin.

It is possible that this acidophil condition causes breaking down of complex colloid combinations with deposition in the choroid plexus, and probable occlusion of the tubules and smaller passages, giving rise to cystic formation. Findlay has suggested that cystic degeneration is nothing but œdema arising from obstruction by hypertrophied connective tissue and concentric bodies. This is probable, but I should regard the hyperacidity of the tissue as the important commencing factor.

In epilepsy and dementia præcox the hypersecretion phenomena and eosinophil reactions were not marked, but in dementia præcox there was abundant lipoid deposition and cystic development; but there was cystic degeneration and fibrous hypertrophy, and even calcareous formation, in the cases of epilepsy examined.

With the cases of mania and melancholia investigated the main abnormal features were hypersecretion phenomena and eosinophil reaction.

The cases of general paralysis showed all forms of degenerative processes, especially enormous fibrous hypertrophy, and complete denudation of epithelium, and these changes were observed in all cases whether young or old, and irrespective of the disease causing death. This would account for the excess of protein present.

Further investigations are in progress and will be published with the full report of the above work.

DESCRIPTION OF PLATES.

Plate I.—Methyl Blue—Eosin Method (Mann).

A. Normal case. No. 74, aged 20. Showing normal structure of epithelium and absence of eosinophil granules. Endothelium and fibrous structure normal.

B. Epileptic. Case 54, aged 34. Showing eosinophil staining in endothelium. Epithelium, very few eosinophil granules; the nuclei show homogeneous staining, with cell and nuclear membranes showing slight eosinophil character.

C. Melancholia. Case 52, aged 50. Showing eosinophil reaction of the epithelial nuclei, with purple-tinted homogeneous cytoplasm, and fibrous hypertrophy.

Plate II.—Methyl Blue—Eosin Method (Mann).

Mania. Case 50, aged 25. Showing marked eosinophil reaction of the epithelial cell nuclei, with homogeneous staining and no granularity. A few morula cells (mulberry bodies) are observed, showing distinct granular character. A few amœboid glia cells (Alzheimer) are seen at the bottom of plate lying detached from the epithelium. Fibrous hypertrophy not marked.

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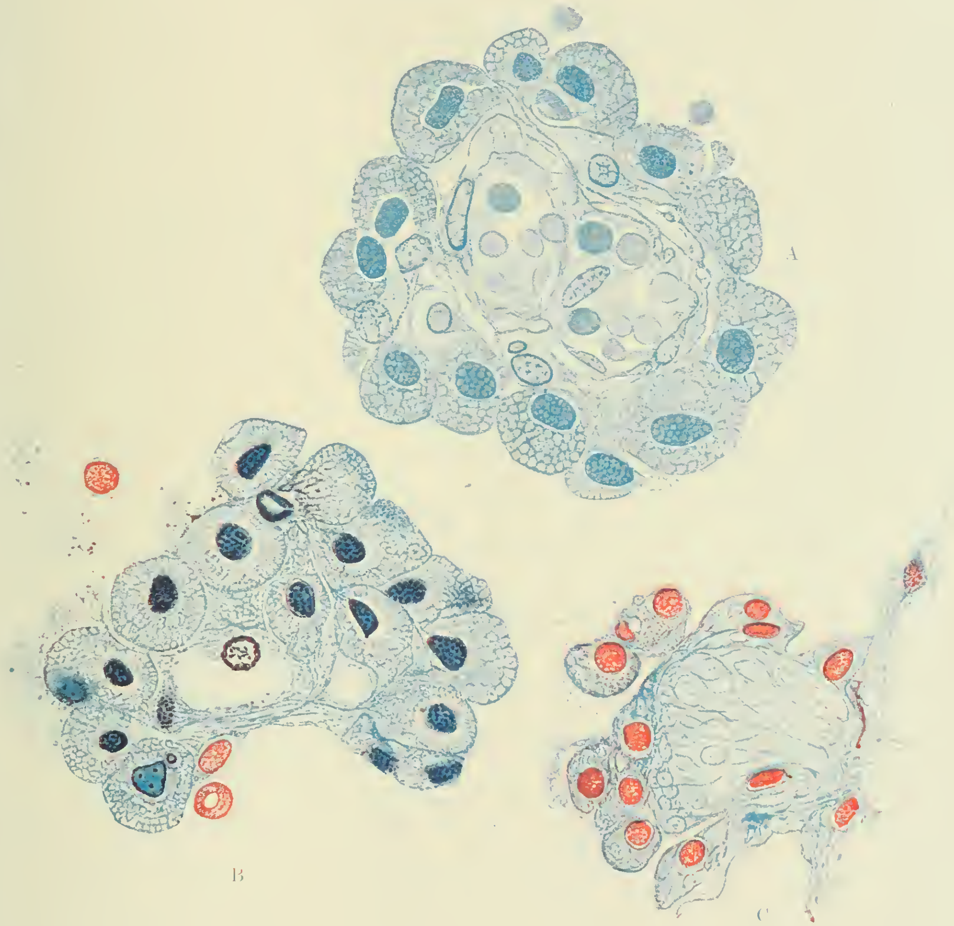
PLATE I.



MOROWOKA:

The Microscopical Examination of the Choroid Plexus in General Paralysis of the Insane, and other forms of Mental Disease

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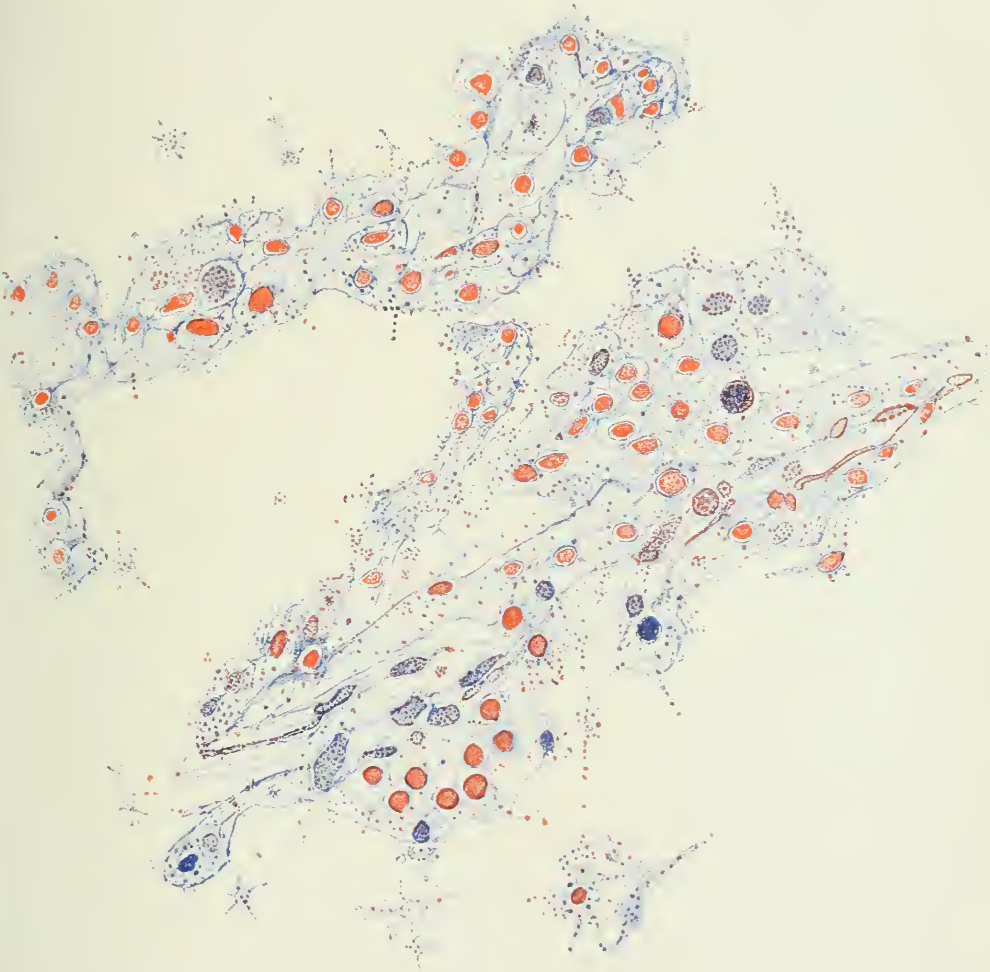
PLATE II.



MOROWOKA:

The Microscopical Examination of the Choroid Plexus in General Paralysis of the Insane, and other forms of Mental Disease.

PLATE III.—METHYL BLUE—EOSIN METHOD (MANN).

A. Dementia præcox. Case 1, aged 20. Specimen selected from most normal part of tissue, away from areas of cystic growth. Showing moderate eosinophil reaction in the epithelial cell nuclei and cytoplasm. No marked fibrous hypertrophy shown in this specimen, which possibly pictures the earliest stage of degenerative process in dementia præcox.

B. Alcoholic dementia. Case 42, aged 53. Showing very faint staining, slight eosinophil character and absence of chromatin. Structure, in general, otherwise normal.

C. Senile dementia. Case 44, aged 65. Showing marked degeneration of epithelium, with slight eosinophil reaction of cytoplasm, and loss of granular structure throughout, especially in the nuclei, and absence of nucleus. Very marked fibrous hypertrophy.

PLATE IV.—METHYL BLUE—EOSIN METHOD (MANN).

General paralysis. Case 47, aged 64. Specimen selected from the most normal part of choroid plexus to show remaining epithelium. Many cell nuclei show eosinophil reaction, with long eosinophil fibres intermingling with each other and ultimately reaching the endothelium. Some cells are shown (*a*) with thread-like processes possibly breaking down fibrous network. Very marked fibrous hypertrophy.

PLATE V.—SCHARLACH R.—HÆMATOXYLIN METHOD (HERXHEIMER).

Dementia præcox. Case 1, aged 20. Selected from normal part of choroid plexus, and stained without acetone treatment. The epithelial cells show large and numerous brown-stained fat droplets and fatty change in the nuclei. Slight hypertrophy of fibrous stroma.

PLATE VI.—SCHARLACH R.—HÆMATOXYLIN METHOD (HERXHEIMER).

General paralysis. Case 47, aged 64.

A. Low power. Showing very marked fatty deposit in the papillæ and connective tissue.

B. Medium power. Showing denudation of epithelium, a few degenerated cells only remaining in crevices of the villi. Fatty degeneration in elastic fibres and connective tissue.

C. Oil-immersion. Showing detailed structure of degenerated epithelium. Fatty changes in endothelium, and epithelial cells and nuclear membranes.

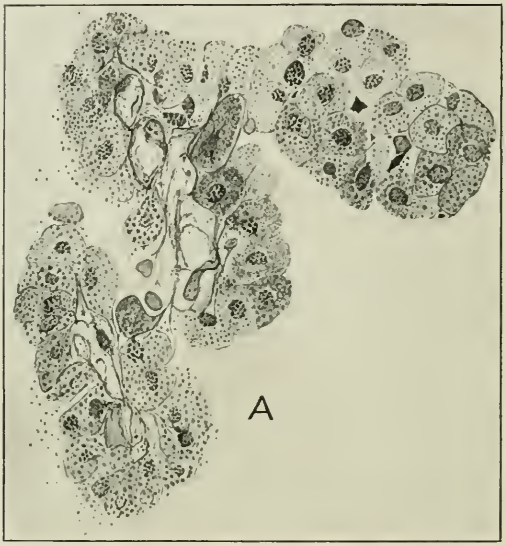
PLATE VII, Figs. 1, 2, 3.—SCHARLACH R.—HÆMATOXYLIN METHOD (HERXHEIMER).

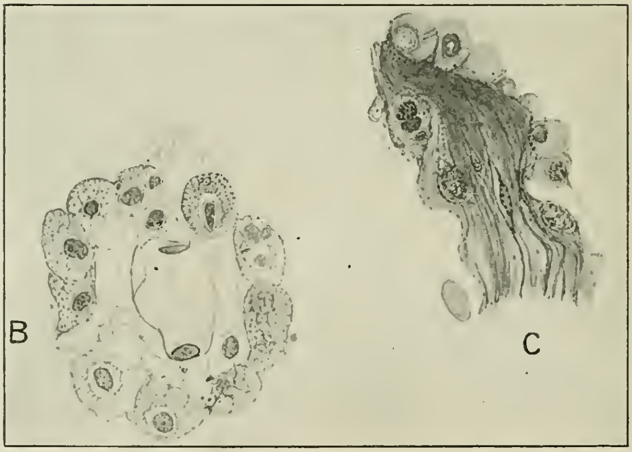
Fig. 1. Normal epithelium of choroid plexus.

Fig. 2. Case 74. Showing slight fatty deposition.

Fig. 3. Case 3 (Dementia præcox). Showing large and numerous lipoid masses. These masses shown so distinctly by scharlach stain; with Nile blue the periphery only takes a purple stain, the central part appearing unstained.

PLATE III.





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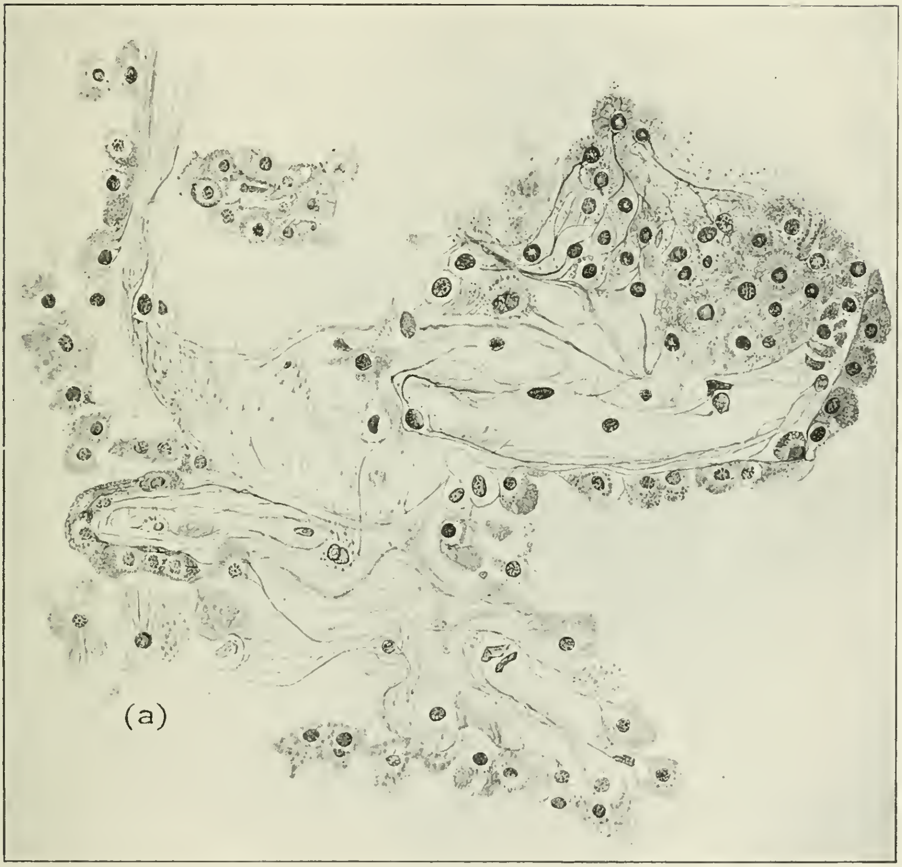

PLATE V.

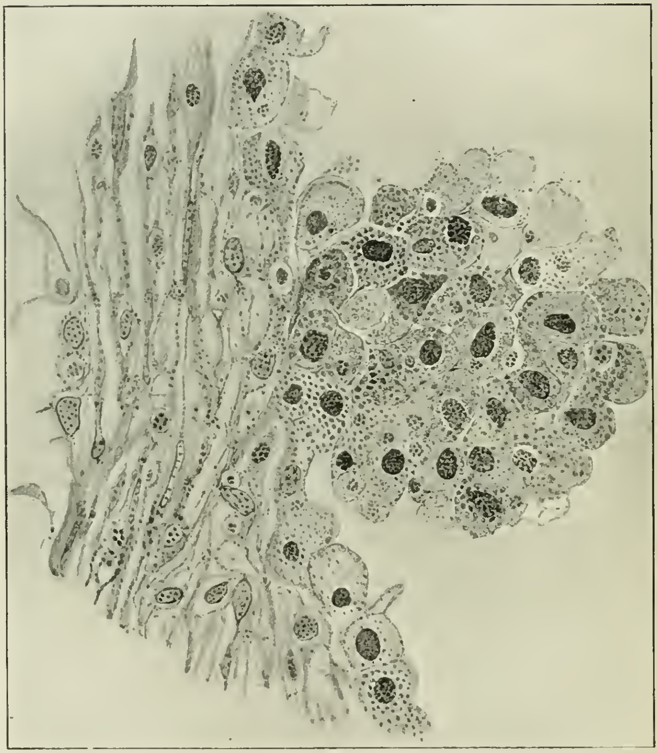

PLATE VI.

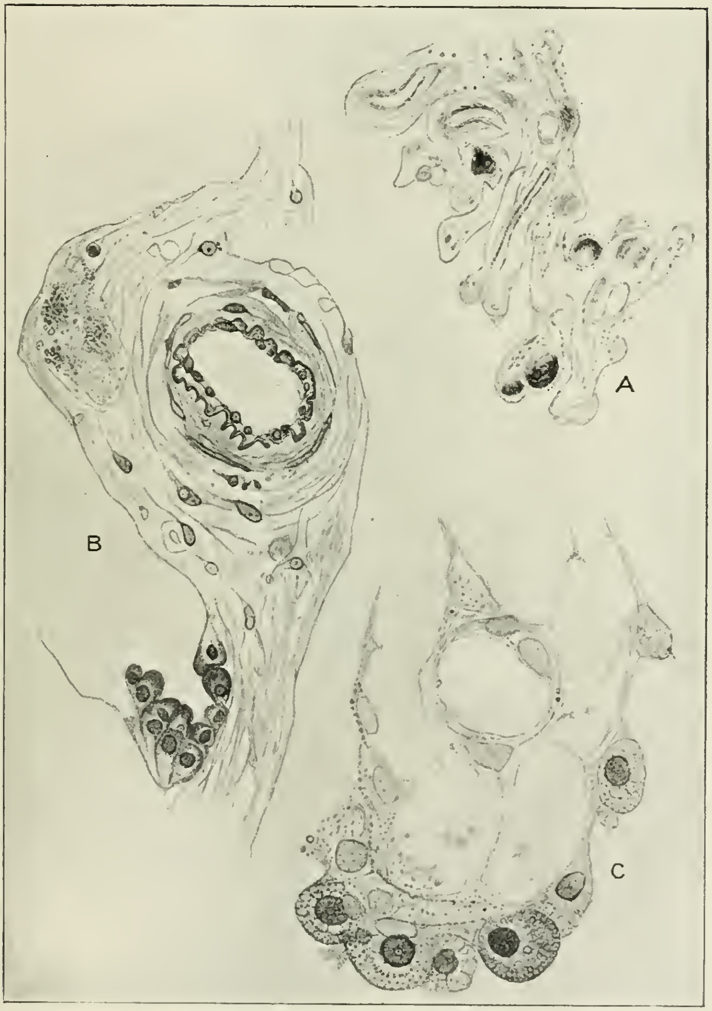

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PLATE VII.

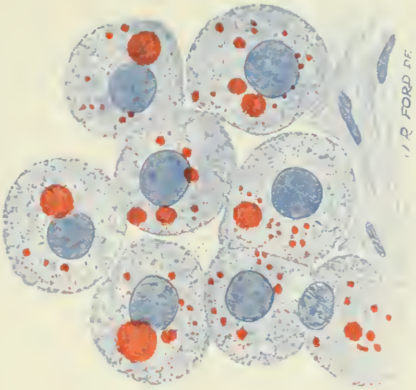

FIG. 3.

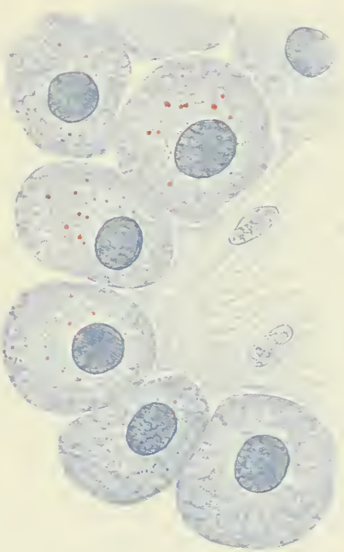

FIG. 2.

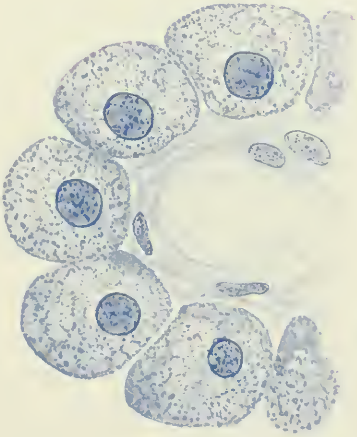

FIG 1

MOROWOKA:
The Microscopical Examination of the Choroid Plexus in General Paralysis of the Insane, and other forms of Mental Disease.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF MEDICINE

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THE EDITORIAL COMMITTEE

VOLUME THE FOURTEENTH
SESSION 1920-21

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The Society does not hold itself in any way responsible for the statements made or the views put forward in the various papers.

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Section of Surgery.

President—Mr. Walter G. Spencer, O.B.E., M.S.

DISCUSSION ON UNUSUAL CASES OF GUNSHOT INJURY OF BLOOD-VESSELS.[1]

The President.

The President said that the subject for discussion would, he hoped, produce an account of cases of which it was not possible at the time to make full notes, owing to the exigencies of military service, but which were remembered owing to their exceptional features.

The following cases had been selected for mention because of their unusual character. On arrival here the men appeared to be doing favourably; the histories they brought with them did not arouse any anticipations of danger. At that time their attention had been much engaged over grave cases, so that the sudden developments which occurred were of the nature of surprises.

Injury necessitating Ligature of all Three Arteries of the Leg.—A private, in June, 1917, was wounded by a bullet which passed horizontally from before backwards between the tibia and fibula, a little below the middle of their length. The bullet cut a notch in the outer border of the tibia, without breaking the continuity of the bone, and escaped through the muscles of the calf behind. When admitted to King George Hospital the case appeared to be one of through-and-through injury, healing without suppuration. Whilst the man was being kept in bed, and without any obvious reason, a sudden swelling of the calf appeared. It was recognized that a diffused aneurysm had supervened and on the assumption that the posterior tibial artery had been wounded, this artery was exposed by an incision along the inner border of the tibia and a ligature applied above the site of the injury. Then the incision was extended downwards a little and a mass of blood clot turned out from beneath the lower half of the gastrocnemius and soleus muscles. Free arterial hæmorrhage followed and so the anterior tibial artery was ligatured by making an incision through the wound of entry along the line of the artery. The artery was tied where it had been wounded in front of the interosseous membrane. As arterial hæmorrhage continued and was not checked by plugging, a third incision was made behind the fibula, through the peroneus longus muscle, and this exposed a wound in a large peroneal artery. After this artery had been tied, all bleeding ceased; the three incisions were sutured and healed without inflammation. The man slowly recovered complete use of his leg. The simultaneous wounding of all three arteries was probably due to the bullet's chipping off and driving before it fragments of bone from the tibia. Two out of the three arteries had been divided in compound fractures; that all three arteries were in this case ligatured without arresting the circulation beyond was doubtless due to the dilatation of the anastomotic circulation during the time between the injury and the development of the diffuse aneurysm.

---

[1] At a meeting of the Section, held November 3, 1920.

A Gluteal Aneurysm cut into a year and a half after the Injury.—A private in September, 1918, was wounded by shrapnel which lacerated the gluteal muscles and grooved the ilium in a horizontal line a little above the sciatic notch. He was treated in six hospitals, where pieces of the ilium were removed. After a year the wound healed for a time, then suppuration recurred and he was admitted to the Westminster Hospital in March, 1920. He presented a dense depressed scar adherent to the ilium with a sinus leading down to bone. Methylene blue was injected into the sinus and the scar excised until necrosing bone was reached and removed. The margins of the funnel-shaped wound consisted of scar tissue densely adherent to the bone. On proceeding to loosen these margins in order to cover in the wound by a flap of muscle and skin, he (the President) cut into an arterio-venous aneurysm which had reached about 1 in. above the sciatic notch. A finger passed into the aneurysm compressed the gluteal artery whilst Mr. Tudor Edwards assisted him by exposing the sciatic notch more completely. Many attempts were then made to ligature the artery for which purpose the sciatic notch was enlarged upwards, but the ligature failed to hold. Finally it was found necessary to tie the internal iliac artery by the transperitoneal method. This controlled the arterial hæmorrhage and the venous hæmorrhage could then be checked by plugging the wound firmly. No further complication occurred and the wound healed soundly from the bottom upwards to the skin in about six weeks. In this case the presence of an aneurysm was unsuspected; there was no sign of it on palpation owing to the covering by dense scar tissue. Perhaps the existence of an arterio-venous aneurysm might have been discovered by auscultation. Had this been the case, then the ligature of the internal iliac artery would have been better carried out first, instead of after the aneurysm had been cut into.

Wound of the Commencement of the Left Axillary Artery and also of the Axillary Vein necessitating Amputation of the Upper Extremity.—A private, aged 27, in June, 1916, was wounded by an explosion: two fragments of shell entered the left posterior carotid triangle just behind the middle of the sterno-mastoid, other fragments, also wire and nails, penetrated the deltoid muscle. After passing through a dressing station he reached a base hospital at Boulogne at which the foreign bodies were removed. When admitted to the Westminster Hospital two months after the injury both wounds were suppurating freely and required dressing three times a day. Two weeks later—i.e., ten weeks after being wounded, there occurred suddenly severe arterial hæmorrhage from the neck and this could only be controlled by firm digital pressure. Whilst the pressure was kept up, an incision was made in the line of the axillary artery and the pectorals were divided. It was then discovered that the artery had been wounded as it lay on the first rib, also the axillary vein; in order to ligature the artery it was necessary to cut across the clavicle. This done, hæmorrhage was definitely arrested. Further exploration revealed a comminuted fracture of the scapula with wide necrosis and suppuration infiltrating the muscles on both surfaces of the bone; the fracture had extended into the glenoid cavity and there was pus in the shoulder-joint—besides there was recent extravasation of blood. Hence an interscapulo-thoracic amputation was necessary, the wound being afterwards left open. The wound healed in about two months; when last seen the man had become quite stout, and the scar was free from pain and tenderness.

Secondary Hæmorrhage from the Tongue.—This case favoured the practice of seeking for the bleeding point; had a proximal ligature been applied, it would almost certainly have been put on the wrong side. A private in September, 1916, was admitted to King George Hospital with a widely gaping wound in the *left* submaxillary region and a compound comminuted fracture of the horizontal ramus of the mandible immediately in front of the angle on the *left* side. He (the President) was much obliged to Lieutenant F. E. Higgins, R.M.O., for a correct history, the notes accompanying the man being quite misleading. A bullet coming from the man's *right* had cut the *right* angle of his mouth, then entered the *right* side of the tongue and passing horizontally across, emerged into the mouth opposite the *left* pillar of the fauces. It next produced the compound comminuted fracture of the *left* horizontal ramus in front of the angle and besides carried away some of the upper molars. The bullet thus drove the fragments of bone outwards superficial to the blood-vessels, and so made a wide wound of exit extending out as far as the *left* mastoid process. On admission there was a free discharge of pus, both outwards and into the mouth. Ten days after the injury there occurred arterial hæmorrhage into the mouth on the *left* side, about 12 oz. of blood being lost. The hæmorrhage was temporarily controlled by packing the left floor of the mouth. This naturally caused the patient great pain: hæmorrhage soon recurred and produced collapse. The situation of the wounded vessel was obscure, so the cheek was rapidly divided from the left angle of the mouth across the site of fracture to the wound of exit. The soft parts and the fractured ends of the mandible having been retracted, and pus, blood clot, fragments of bone and teeth having been wiped away, the hæmorrhage was found to be coming from a hole in the tongue on the left side. The track was followed by laying it open across the dorsal aspect of the tongue when it was found that the *right* lingual artery had been wounded just about the origin of the dorsalis linguæ, whilst the *left* artery was intact. After a ligature had been applied no further hæmorrhage occurred. The incisions in the tongue and cheek were united by sutures, and three weeks later the patient was transferred to the dental surgeon. Five months later the fragments of the jaw were in good position, but the union had not yet become firm. The tongue had quite healed.

Wound of the Left Carotid Artery, Internal Jugular and Vertebral Veins: Diffuse Aneurysm; Hemiplegia following Ligature.—A private, aged 28, in September, 1916, received superficial wounds by fragments of shell on the head, left shoulder, left buttock; in addition one fragment penetrated the left neck. On X-ray examination the fragment was found lodged anterior to the left transverse process of the sixth cervical vertebra. When admitted to King George Hospital, there was nothing but a small scab covering a puncture on the left side of the neck which appeared nearly healed. Nine days after the patient awoke, complaining that he had just "cricked" his neck and felt pain: the Sister found a pulsating swelling which seemed about to burst through the scab. It was recognized that a diffuse aneurysm had formed. An incision was made along the whole length of the left sternomastoid and the muscle retracted, when the deep cervical fascia was exposed, infiltrated by recent blood. Blunt methods of dissection in the line of the vessels were employed, and ligatures were first placed on the common carotid and internal jugular vein below the site of the injury. Then the same vessels were exposed above the aneurysm and ligatured, meanwhile bleeding had been controlled by direct pressure. The finger was next inserted into an excavation in the neck, and clot, both laminated and soft, was removed, also the fragment of shell. It had produced a lacerated wound in the carotid artery and jugular vein about 1 in. in length. Free oozing of venous blood followed the removal of the foreign body, but it could be controlled by the finger pressing just below the sixth transverse process and no pulsation could be felt there. It was therefore assumed that the bleeding was from the vertebral vein. A gauze plug was applied firmly and the rest of the wound sewn up. The plug was removed four days later and the wound healed without complications. The patient soon recovered consciousness, but exhibited complete right hemiplegia and aphasia. Food escaped from his mouth unless it was inserted far back, when he swallowed it easily. He understood all that was said, but in attempting to speak, giggled and made guttural noises. As soon as he had somewhat recovered he was set to write with his left hand and to try to pronounce the letters as he wrote them. Five weeks subsequent to the operation he was able to repeat some words after an obvious effort and with a special tendency to giggle. He had regained much movement of the leg at both the knee and ankle, but the right arm was still paralysed. Eight weeks after the operation the right leg was spastic and he walked by moving it at the hip; some slight recovery of movement had returned in the right arm; he had made progress in writing with the left hand and in articulating the words written, but his free speech was very defective. It was still accompanied by giggling when he was pleased, but if chaffed he became petulant and cried. Five months after the operation he could walk without a stick, but had still some spastic rigidity about the right knee. There was some further improvement in the right arm and in speech, but both were still much impaired in function when the man was examined two years after the operation.

Wound of the Left Vertebral Artery consequent on Fracture of the Atlas; Diffused Aneurysm; Fatal.— A private, aged 20, had been wounded by a machine-gun bullet which had entered immediately behind and below the left mastoid process and had fractured the left horizontal ramus of the mandible at the junction of the bicuspid and molar teeth. An X-ray photograph recorded merely a fracture of the mandible. On admission to King George Hospital, the wound of entry had healed leaving a circular, depressed scar. The fractured jaw was fixed in a dental splint and was uniting. There was no sign of the foreign body, which had presumably escaped by the mouth. A few days after admission, attention was attracted for the first time to a swelling under the scar below the left mastoid process with induration around, and it was supposed that suppuration was threatening to recur at the point of entry. The next day it was noted that the swelling yielded an aneurysmal pulsation and a systolic bruit. The diagnosis then made was that of a suppurating aneurysm connected with the external carotid artery, or its occipital, or posterior auricular branch. An incision was therefore made along the line of the external carotid artery, when enlarged glands were met with, and evidences of peri-adenitis, together with a recent infiltration by blood. When the external carotid artery was exposed, a ligature was passed round it but on tightening the loop the pulsation in the swelling was not arrested. At the moment it was conjectured that the occipital artery arose below the level of the ligature on the carotid. During the search for it, the aneurysm was penetrated, and there was a sudden gush of blood under high pressure. The finger thrust into the hole reached a fracture splitting horizontally the left transverse process of the atlas, and the blood could be felt to spout out through the fissure so made. This was plugged by gauze, held in place by the assistant's finger, whilst the incision was extended down the neck. The parts were obscured by previous glandular inflammation and recent infiltration by blood, hence the sternomastoid muscle was cut away. An attempt to expose the vertebral artery between the fourth and fifth transverse processes failed, so a ligature was passed which included the artery and vein as well as the muscle between the transverse processes. This so far controlled the hæmorrhage that the digital pressure on the plug could be released and no more external hæmorrhage occurred. The patient did not recover consciousness; there was no reaction to the treatment for shock; he died eight hours after the operation; a post-mortem examination was not permitted. Unfortunately there was nothing beforehand to indicate an injury to the left vertebral artery on the arch of the atlas. It would appear that as the bullet entered it struck the tip of the transverse process of the atlas, causing a horizontal fissured fracture and a splinter from the fracture punctured the artery. Had the true nature of the injury been known before the commencement of the operation, the safest plan would have been to have tied the *right* vertebral artery first. In any case there would have been a difficulty in tying the vertebral artery on the injured side because of the previous adenitis and peri-adenitis, as well as the extravasation of blood. It was believed that the immediate cause of death was an extravasation of blood which compressed the meninges about the foramen magnum and atlas.

Excision of an Aneurysm which communicated with a Plexus of Anastomosing Vessels.—An instance of the dilatation of anastomosing vessels into a plexus was met with in the case of an officer admitted to the Fourth London General Hospital. The superficial femoral artery had been wounded in Hunter's canal and operated upon, but no details could be obtained. On admission the circulation in the leg and foot was very poor indeed. As it improved an aneurysm developed in the scar until the skin over it became very thin. He then removed the superficial portion of the sac and noted, besides the artery entering and leaving the sac, three equally large vessels opening into the sac on its deep aspect. The remainder of the sac was sutured and after this operation the circulation in the foot and leg became quite good, but the aneurysm dilated again and began to point. At the second operation the aneurysm was excised completely, the three large arteries communicating with the profunda femoris were of the size of the superficial femoral itself, and, besides, several other smaller arteries entered the sac. When last seen the officer had regained good use of the limb. A similar dilatation of anastomosing arteries into a plexus was noted in cases of late secondary hæmorrhage from compound fractures and amputation stumps.

Sir GEORGE H. MAKINS referred to cases which possessed some unusual characters. He first mentioned the occasional loculation of the sac met with in false aneurysms following gunshot injury. It was obvious that the blood escaping from a wounded artery tended to spread in the direction of least resistance, either along the vascular cleft, between the muscles, or along the course taken by the missile which caused the injury. The last named was of most importance with regard to the occurrence of loculation, the missile passing from one to another compartment of a limb or the trunk. The commonest example was furnished by wounds traversing the thigh, where it was not unusual to find a false aneurysm in the femoral vascular cleft and a large blood cavity or mass of clot in the adductor region, the two being connected by a narrow neck at the point at which the missile had pierced the facial boundary which separated the two compartments. Another common occurrence was the primary formation of two pools of blood on either side of the interosseous membrane between the bones of the forearm or leg. In any of these cases the collection of blood in the compartment distal to the wounded artery usually coagulated and formed no part of the final aneurysmal sac. Occasionally the secondary portion of the sac might be cut off, the contained blood might deposit clot, and a collection of fluid serum might remain in direct apposition to, but not in communication with, the definite aneurysm. In illustration he mentioned a case of wounding by a bullet of the second portion of the subclavian artery. An extensive extravasation of blood into the area of the posterior triangle of the neck resulted, a part of the effusion being deep, and limited by the deep cervical fascia, a second portion being superficial to that structure. A well-defined aneurysm was found beneath the anterior scalene muscle, while superficial to the fascia a large fluid collection remained. The matter was one of practical importance because pulsation was communicated to the fluid of the superficial cavity and the condition was thought to be one of immediate danger. An operation on the fourteenth day showed a loculus full of straw-coloured serum, and it was evident that no urgency had really existed for early operation. In ten cases in which there was an injury to the subclavian artery—which at the same time had been the source of the blood in a hæmothorax—the subclavian aneurysm was small and developed tardily. It was assumed in explanation that the blood passed in the direction of least resistance into the pleural sac, and that any large primary collection of clot or blood in the neck did not take place. The sac in traumatic aneurysms was sometimes formed by unlikely structures. He mentioned a case in which an old tuberculous cavity in the apex of the right lung provided the sac of an aneurysm, or rather an arterio-venous hæmatoma, which formed in connexion with the innominate artery. The pleural sac had been obliterated by adhesions secondary to the tuberculous disease, hence the blood from the wounded artery and vein passed in the direction of least resistance into the cavity of the lung. The patient died on the seventh day after profuse hæmoptysis. Mr. Lawford Knaggs had published a case in which the sac was located in the substance of a fractured humerus, raising the suspicion of a malignant tumour. More than one case had been observed in which ossification of the sac was commencing at an early date. This had been seen particularly in the thigh, in instances in which the femur was implicated, and the condition threw some light on that of traumatic myositis ossificans. It would be interesting to know if any cases of traumatic aneurysm of the aorta had been observed. In the War Office collection several wounds of the aorta were to be seen, some so limited in extent that there was reason to believe that if the patient had not died from other causes the injury might have remained undetected. Two specimens of extensive wounds were of interest. In one case there was a large arterial hæmatoma, and the patient died on the sixteenth day as the result of hæmorrhage and toxæmia, and the abdominal swelling had not attracted attention during life. In the second a false aneurysm of the thoracic aorta was reaching the condition of a well-defined sac when it burst into the gullet on the thirty-seventh day. The rarity with which infection took place was somewhat remarkable. In looking through a large series of cases a number in which fragments of shells were found within the sac rendered this the more striking, since the clot must have had to contend with gross contamination. It might well be, however, that some of the numerous cases of early secondary hæmorrhage or extension were really to be referred to this cause. Infection might also be the explanation of tardy development in some of the cases in which an aneurysm was only detected at a late date. Experience gained in the war had familiarized them with the effect of infection on partially injured vessels, in giving rise to secondary hæmorrhage, and to development of aneurysms in the exposed extremities of large arteries in infected amputation stumps. He asked whether any members present had seen well-developed venous sacs in cases of arterio-venous aneurysms. For many reasons he had been inclined to doubt the occurrence of this form of arterio-venous aneurysm, although the description of it was classical. One such specimen was contained in the War Office collection.

Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.

President—Mr. E. Laming Evans, C.B.E., F.R.C.S.

Functional Results of Successfully Reduced Congenital Dislocation of the Hip.

PRESIDENT'S ADDRESS.[1]

By E. Laming Evans, C.B.E., F.R.C.S.

A consideration of the functional results of successfully reduced congenital dislocations of the hip opens up for observation and discussion a subject matter which is only now becoming available. If we review shortly the methods of treatment before the manipulative period, we find that continuous extensions, with or without abduction, never led to a successful reduction. If, in the course of such treatment, the femoral head lay over the acetabulum the head was kept off the acetabular floor by infolded capsule, and progressive displacement occurred when extension ceased. It is not often that we have an opportunity of examining such a case nowadays, so I do not hesitate to show you a series of skiagrams illustrating the functional results.

Nearly fifty years ago, Mr. William Adams carried out the treatment described by Buckmaster Brown upon a doctor's daughter, N. W., who had left-sided congenital dislocation. The treatment lasted several years, but I cannot give you further details. I show you skiagrams taken in 1907, 1909, 1913, 1920. On the left side the femoral head is upon the dorsum ilii: it would be impossible to say by clinical or X-ray examination that any treatment had been carried out. On the right side, the X-ray of 1907 shows a shallow acetabulum, with half the femoral head outside the acetabulum, unsupported by any roof. Such a condition is not infrequent in cases which are, clinically, unilateral: Hoffa maintained that it occurred in 25 per cent. of cases, but it has not occurred so frequently as this in my series. Beyond some flattening of the postero-internal pole of the femoral head and shallowness of the acetabulum the changes are slight. Pain at this time was increasing and functional ability diminishing; in the skiagrams of 1909, 1913, and 1920 progressive osteo-arthritic changes are seen: and now a Baker's cyst, the size of a tangerine orange, is distending the anterior part of the capsule, and the disability is so great that she avoids any walking, standing or stooping. Comparing the two sides, the dislocated hip is painless and, in a very limited way, is a better functional organ than the undislocated hip.

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[1] At a meeting of the Sub-section, held October 5, 1920.

I may here remark how difficult it is to standardize hip-joints as functional organs. Range and power of mobility are useful tests but offer unreliable data for estimating the functional results exhibited in walking and standing. I have, during the last ten years, had an opportunity of examining, at the Royal Surgical Aid Society, seventy-nine cases of adults suffering from congenital dislocation of the hip, in which no operative treatment had been undertaken. In each case, the degree of direction of mobility, the power of mobility, and the degree of displacement were noted. In general terms it may be said that the degree of displacement caused a shortening rarely in excess of 2½ in.: that functional disability increased rapidly between the ages of 20 and 30, and that after 30 a walk of over one mile was rarely voluntarily undertaken—that the direction of displacement influenced functional disability after 30 only slightly. In some cases the functional disability was out of all proportion to the physical signs, and the patient was practically house-ridden.

Turning to the next period of treatment—the Hoffa-Lorenz method by open exposure and by shaping the femoral head and acetabulum before reduction—I think such results should be considered as nearthroses rather than as successful reductions. However we regard them, the results must be considered poor: in fact, they have been disastrous, adding marked deformity and increasing functional disability. Further, no one has produced clinical and X-ray evidence of permanent functional success lasting, even, in a single case, over a long period of years.

I here show you an X-ray of a right hip, reduced by open operation by the late Mr. Keetley in 1905 in a patient aged 10. Ten years later, functional disability increased, and the accompanying X-ray was taken in 1915. There is now 2½ in. of shortening, and functional activity is rapidly diminishing, a result accelerated by canteen work during the war.

X-ray examination of other cases treated by surgeons of undoubted operative skill have, in all cases, failed to disclose a permanent reduction. I do not here include the open operation of arthrotomy performed with a view to dilate a constricted isthmus and so to facilitate reduction by manipulation. I have no results to show, but hope that others who have will show them.

Turning now to cases treated by manipulation, Paci, Lorenz, and others, were employing this method during the last few years of last century. In England, cases were first treated by manipulative methods in 1903. Some surgeons may have successful reductions dating from that year. Personally I regret that I have not, and for the reason that the method employed involved much more force and tearing of healthy parts than was subsequently found to be necessary, and partly because of the difficulty of getting satisfactory X-ray records.

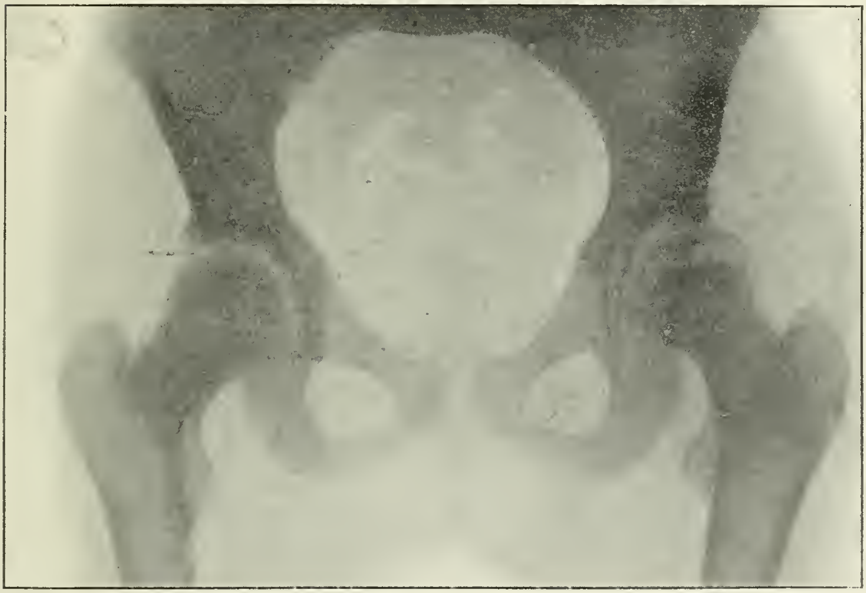

Fig. 1.

Case of P. J. Ten years after reduction, as seen in 1920.

In my earlier cases in 1903, reductions were undoubtedly obtained, but inefficient after-treatment and the method of reduction combined to cause the reduction to be unsuccessful owing to failure of retention of the reduced head. In all eighty-one cases have been dealt with, but the difficulty of keeping in touch with hospital patients has been greatly increased by the war and the advanced railway fares. I regret that I cannot to-night show any cases reduced before 1910, but I hope at subsequent meetings to do so and I hope others will do so likewise.

In the case of P. J., the dislocation was reduced in January, 1910, at the age of 2¾. In January, 1912, the legs were equal, 19¼ in., and function perfect. This case has been observed yearly and X-rays taken.

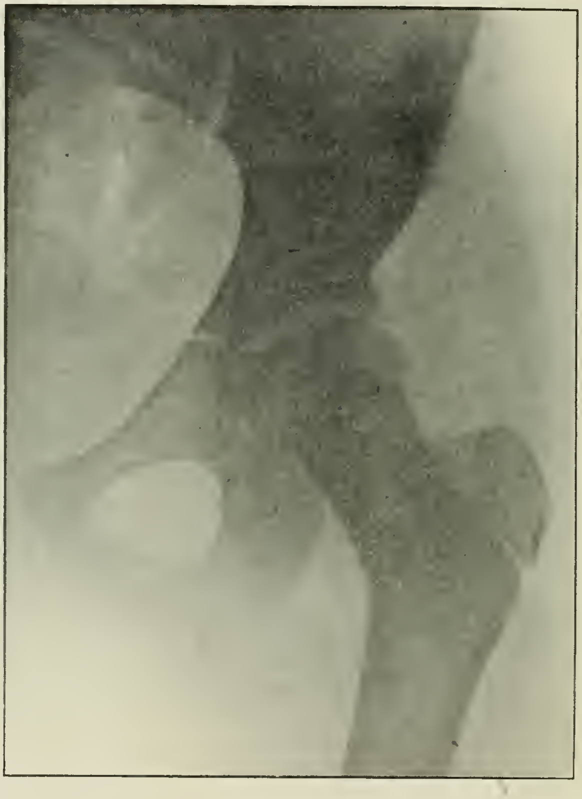

Fig. 2 L.

Case of M. B. Nine years after reduction, as seen in 1920.

I show you the series; in January, 1920, the legs were equal, 30 in. The functional result is perfect yet the X-ray shows that only three-quarters of the femoral head is covered by an acetabular roof, and the chances of decrease of functional activity between the ages of 20 and 30 are suggested by the osteo-arthritic changes seen in the case of N. W.

I also show the case of M. B., reduced nine years ago at the age of 4 years 2 months: the functional result is no better than in the preceding case, but the X-ray shows a more perfect joint, and an acetabular roof which fits perfectly over the weight-bearing femoral head. The prognosis for future functional activity in this case appears to be good.

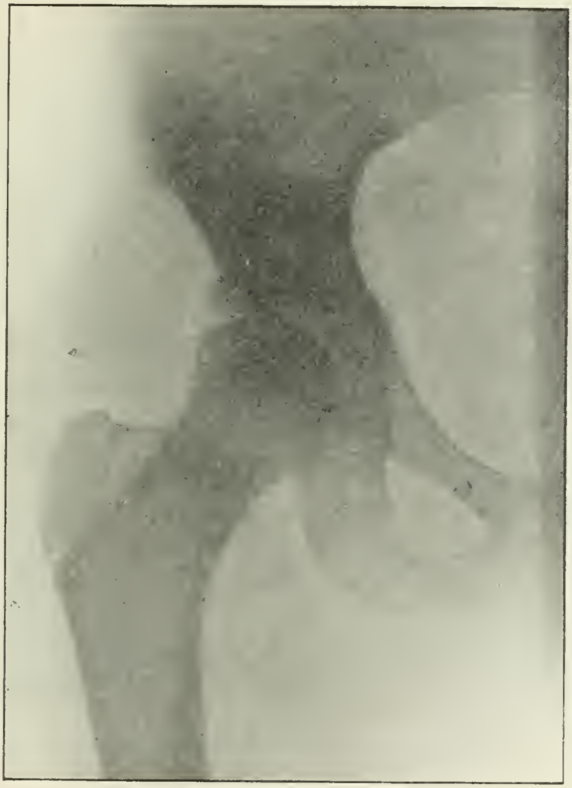

FIG. 2 R.

Case of M. B. Nine years after reduction, as seen in 1920.

M. S. Dislocation reduced in 1910, at the age of 3 years 3 months. I show you the series of skiagrams. The result is functionally perfect and the X-ray shows a femoral head fully covered by a well defined acetabular roof. I see no reason why the reduced joint in this case should not stand the stresses and strains of an ordinary life without showing any degenerative changes.

M. G., a bilateral case, reduced in 1910 at the age of 7. The last X-ray was taken in 1916, six years after reduction. Unfortunately she died in 1918 of influenza without my knowledge, and the joints were not preserved. I saw this girl a few months before death: the legs were equal in length and she walked well and free from limp or waddle or pain. The X-ray, however, shows, on the left side a varal deformity of the neck, and of the other, an absorption of the head and neck. I cannot but think that the prognosis of function in such joints is bad, and that this is a class of case in which the benefit will be limited to adolescence and early adult life.

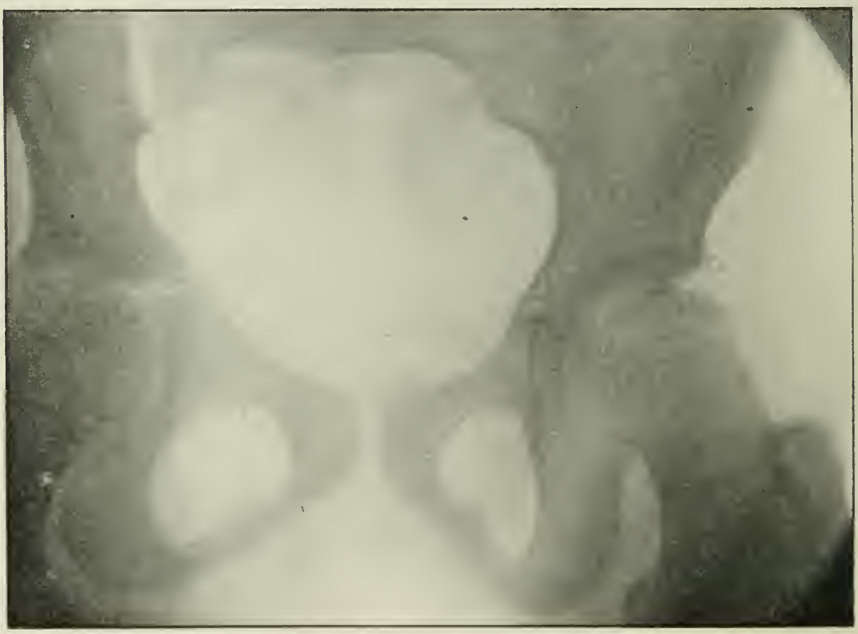

Fig. 3.

Case of M. S. Ten years after reduction, as seen in 1920.

L. B.—Left-sided dislocation reduced ten years ago at the age of 5. The acetabulum was very poorly developed as is shown in the skiagram before reduction. The functional result at present is quite good, though there is ¾ in. shortening. The joint movements are good: she walks well, without pain or sense of fatigue. I show you a skiagram taken in June, 1920, ten years after reduction. The acetabulum is still poorly developed and shallow and the femoral head has worn for itself a new socket at the junction of the upper part of the acetabulum and the roof. The prognosis for the ultimate use is not good.

I have endeavoured to place before you the present functional results and X-ray findings of some cases I operated upon in 1910 or about that time which can be traced at present or are available to re-examination and to indicate the lasting capacity of reduced joints as articular organs.

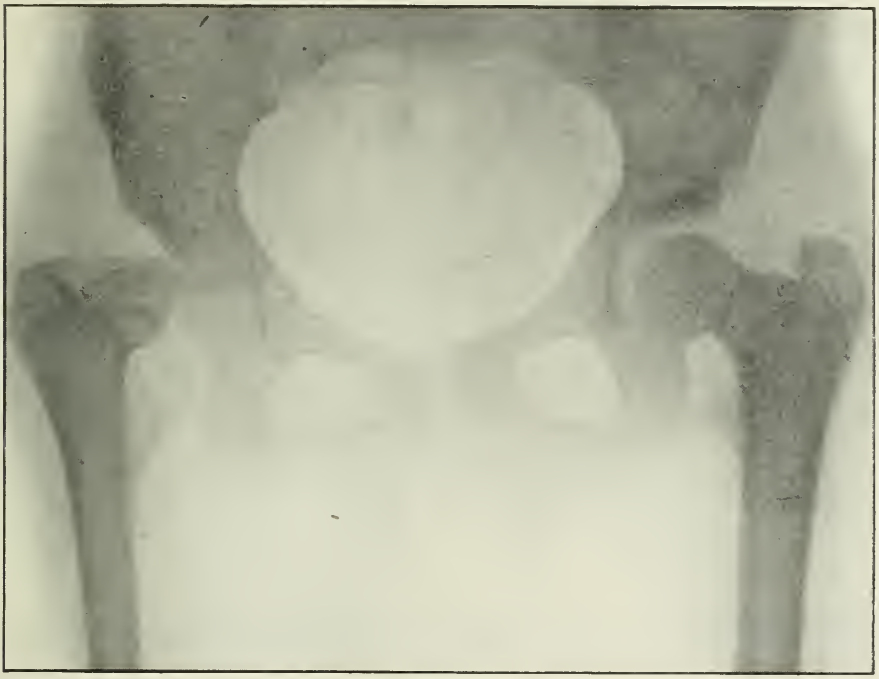

Fig. 4.

Case of M. G. Six years after reduction.

Four main principles of treatment result from observations during the course of this inquiry:—

(1) Reduce early.
(2) Reduce gently.
(3) Retain concentrically.
(4) Encourage early function.

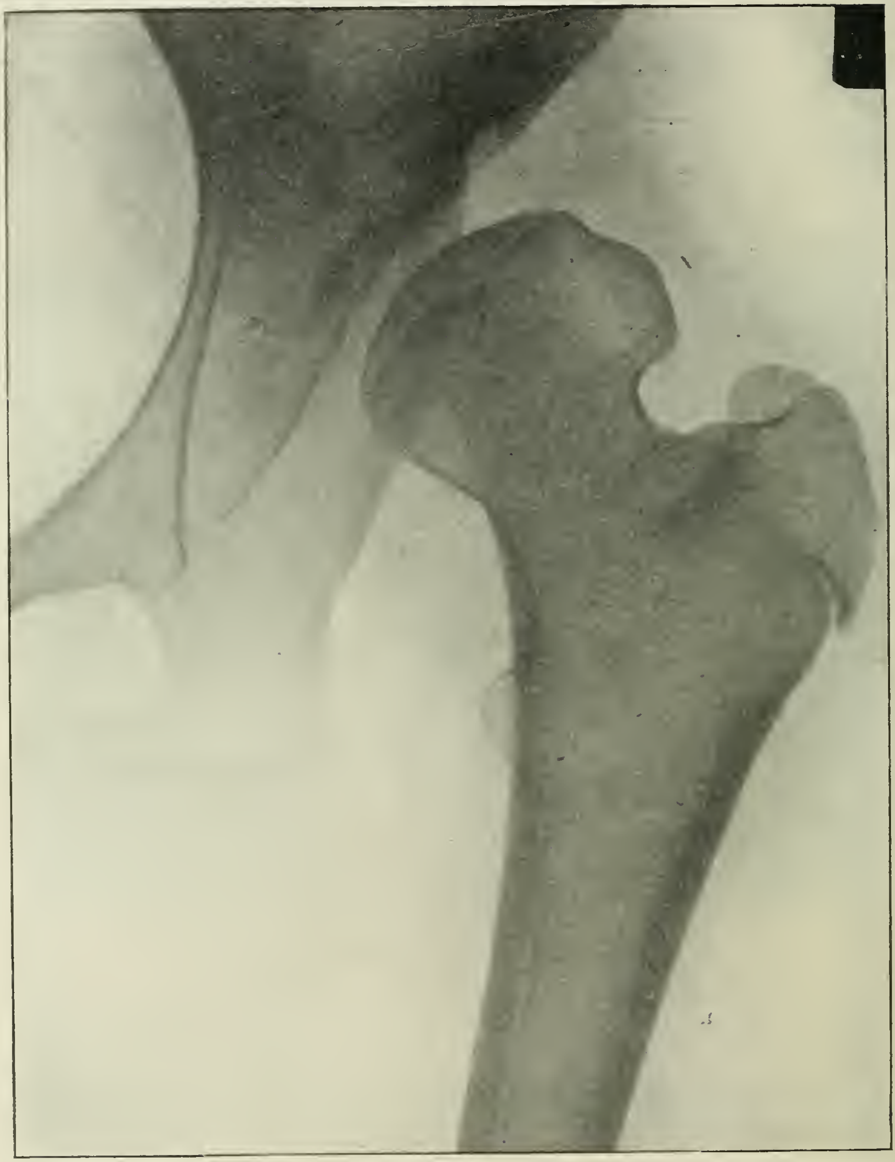

Fig. 5.

Case of L. B. Ten years after reduction, as seen in 1920.

DISCUSSION.

Mr. FAIRBANK said that failure to obtain a good functional result in a case in which an anatomical cure had resulted appeared to be due either to "arthritic" changes in the joint or to failure of recovery of the muscles—e.g., adductors damaged at the time of reduction. As regards arthritic changes, these could develop during the later stages of the treatment, subside with rest, and a good result be obtained. Or a more insidious change might take place—"absorptive arthritis" he had been in the habit of calling it, with a gradual wearing away of the head and neck of the femur, and sometimes of the acetabulum as well, with a gradual migration of the femur upwards. Then there were the changes described under the title of "pseudo-coxalgie." These changes did not, in his experience, interfere with the ultimate perfection of the result. Were the absorptive changes above alluded to an advanced stage of "pseudo-coxalgie," and were both essentially traumatic in origin, and were the arthritic symptoms—e.g., spasm and rigidity—simply the result of a sprain of the joint during convalescence, or was there an infective element at work? Further investigation was necessary to clear up these points. The fact that arthritis was commoner after "open" than after manipulative reduction, even though the wound in the former healed by first intention, rather suggested infection as the cause. The radiograms were of a case of unilateral dislocation reduced by manipulation (at the third attempt) at the age of 9. Ten months later the patient had a fall, and arthritic changes were present for many months afterwards. Though absorption did not occur, a late gradual migration upwards of the femur took place, with poor function. Here were two cases of pseudo-coxalgie following reduction and giving good final results, one in a child operated upon at the age of 1 year 8 months, and the other at the age of 5½. The latter showed an excellent result over four years later, but the radiogram made him wonder whether the good result would be permanent. The next radiogram was of a bilateral case in which pseudo-coxalgic changes developed on one side and not on the other. The functional result was excellent three years after the operation. It might be of interest to note that damage to the adductors on the affected side was somewhat excessive. The last case was a bilateral one operated on at the age of 7, and showed the typical result of absorptive arthritis with a deplorable functional result. This case had helped him in deciding that an age limit should be fixed beyond which it was inadvisable to attempt reduction. In this connexion it might be of interest to mention a recent experience. A few weeks ago he had had the opportunity of examining a lady, aged 25, upon whom Lorenz had operated for bilateral dislocation, in Vienna, when she was aged 8—i.e., seventeen years ago. She was under treatment for two years and, after an interval, for a further year. No radiograms had been taken since the operation. The result was said by the mother to be a most wonderful cure, particularly for her age. On examination the result was found to be anything but a cure. The trochanters were somewhere near the crests of the ilia, and nothing could be felt of the heads of the femora, and he imagined they had disappeared. Functionally the result was wonderfully good, though by no means perfect. There was no lordosis whatsoever. She could walk many miles, but did not play games, apparently through disinclination. Trendelenburg's sign was just present on one side, and absent on the other. She stated that she rarely suffered from pain in the hips, but it was noteworthy that they kept a tame masseuse who gave her treatment from time to time! For obvious reasons a radiogram was not taken, though one had been greatly desired. This case made him wonder whether it would not be possible to cure the lordosis and improve the function in a case above the age limit without attempting a true reduction.

Mr. OPENSHAW drew attention to the fact that cases of congenital dislocation of the hip were now met with at a much earlier age than used to be the case. He had operated on cases of congenital dislocation of the hip by Lorenz's method since 1896. In 1898 he showed cases of cure. After the South African War he published a paper in which he pointed out that Lorenz's method did not cure every case of congenital dislocation of the hip, owing to anteversion of the neck or imperfect reduction, subsequent contraction of the adductors, or other causes. He agreed with the President's statement that osteo-arthritis usually began, and became aggravated, between the ages of 20 and 30, and at the latter age it was not unusual for a patient to be able to walk only a quarter of a mile. If the cases were met with between 3 and 4 years of age he considered that eighteen out of twenty ought to be perfect cures, and he considered that the subsequent onset of osteo-arthritis was not necessarily to be expected.

Mr. BANKART said that he had seen a good many cases treated by the Lorenz method, and he thought that the fear of redislocation after reduction had been exaggerated, and that the attitude of hyperextension had been overdone, with the result that in a very large proportion of the cases the head of the femur was in front of, and not truly in apposition with, the acetabulum. He believed that more accurate apposition was obtained when the femur was rotated inwards—especially when there was anteversion of the neck—and he had for some years adopted an attitude of 45° internal rotation and abduction as a routine second position. It was necessary to include the knee bent to a right angle in the plaster. He disagreed with the practice of encouraging or allowing children to walk or crawl in plaster soon after reduction. The development of the hip-joint was favoured by constant pressure of the head of the femur against the centre of the acetabulum. The source of this pressure was muscular retraction and not movement. Movement only served to dissipate the pressure from the centre of the acetabulum. He did not allow the patients to walk until there was X-ray and other evidence of stability at the hip-joint. He also deprecated the routine division of the adductors and preliminary stretching or rupture of muscles before reduction. He had seen several cases in which, although the hip had been reduced, the gait was greatly impaired by permanent injury to the muscles. He did not manipulate the limb in any way before reduction, and only occasionally was it necessary to divide the tendon of the adductor longus in older patients. He believed that treatment on these lines gave far better results than could be obtained by strict adherence to the original technique of Lorenz.

Muscular Dystrophy in a Boy aged 7 Years 9 Months.

By PAUL BERNARD ROTH, F.R.C.S.

NOTHING was noticed wrong until he started to walk at 13 months, when he "rocked" very much, and in getting up from the ground "used to put his hands on his knees as if he was an old man."

On examination there was found to be a paresis of all the muscles of his lower extremities, and of those of the shoulder-girdle in the upper extremities. He was only just able to stand in a severe double genu valgum position, with the two knees together, the two feet wide apart, and the two hands placed on the two knees. When put supine on the floor he was just able to roll over into the prone position, and very slowly and gradually wriggle and draw himself up into the standing position described, by means of a chair; taking two minutes to the whole process, and expending a great amount of energy. There was no fibrillary twitching of the muscles, the condition did not seem to be getting worse, and the boy's intelligence was above par.

I have lengthened the tendo Achillis of each foot, as it had become contracted, and have fitted him with a pair of Thomas's calliper knee-splints, which enables him to stand erect in comfort, to get about the room with much greater ease than before.

Case of Brittle Bones in a Young Man aged 20.

By PAUL BERNARD ROTH, F.R.C.S.

THE patient was "rickety from birth," with knock knees: he was operated on for this when aged 10 at St. Thomas's Hospital. He was very small for his age. Five years ago, when aged 15, his legs got weaker and for two years he was not able to walk at all. Three years ago he began to get about again, but this was hardly to his advantage, for he broke in quick succession his left forearm, right thigh, both thighs just above the knee, and his left collar-bone. He now has severely distorted femora and is only 4 ft. high. His head bulges distinctly in the temporal region over the ears.

I have had him fitted also with Thomas's calliper knee-splints, moulded to the curves of his thighs, thereby enabling him to stand, and in a short while, it is hoped, to walk.

Further Report of Case of Bilateral Congenital Elevation of Scapula.[1]

By H. A. T. Fairbank, M.S.

Radiogram taken with the left arm fully elevated failed to show any downward displacement of the head of the humerus, though this apparent displacement was pointed out by Mr. Bankart and Mr. Elmslie when the case was shown. No adequate explanation can be offered for the surprising mobility of the left shoulder-joint, which allows of vertical elevation of the left arm while the right is checked long before the vertical position is reached.

Electrical examination: Trapezius below the level of spine of scapula, no response right or left; rhomboids acting; serratus just acting left, very weak right; spinati acting; levator anguli scapulæ acting.

Osteitis Deformans.

By H. A. T. Fairbank, M.S.

S. Y., female, aged 58, married, complains of pain in left leg, below knee, since November, 1919; getting worse. Worse after standing or walking and in bed at night; pain in right hip and left foot sometimes.

History: one son, aged 30; no miscarriages; no evidence of syphilis; no headache; teeth all removed.

On examination; Pain and tenderness (quite definite) in both calves and soles of feet, particularly left; both arches of left foot are giving way; knee-jerks present; left tibia thickened in upper half or more, and curved anteriorly; anterior edge rounded; other tibia normal. Femora: ? Both a trifle thick in lower third. Spine normal. Nothing else found abnormal. No obvious source of infection. Wassermann reaction negative.

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[1] Shown at a meeting of the Sub-section on May 4, 1920. See *Proceedings*, 1920, xiii (Sect. Surg., Sub-sect. Orth.), p. 236.

X-ray examination shows diffuse thickening of upper two-thirds of left tibia with increase of anterior curve. There are a number of clear spaces, mostly small, in the anterior portion of the bone, and one larger space more than ½ in. in diameter in the centre of the upper third of the bone, shut off from the medullary cavity. The upper limit of this space is 2 in. below the articular surface. This is the only clear area which suggests the presence of a cyst. The shaft of the other tibia is a trifle thickened, but there is no honeycombing. The right fibula shows some thickening, but not the left. The shafts of the femora seem to be unduly thick and dense for a woman. The medullary cavities are not well defined. The hip-joints and pelvis show nothing abnormal. The cranium is definitely and uniformly thicker than normal.

The diagnosis in this case would appear to be clear. As to treatment, she has been put on a diet almost wholly proteid; carbohydrates have been reduced to a minimum. The patient says she is better, but as the alteration in diet was only commenced two or three weeks ago, it would be unwise to draw conclusions.

Deformities Associated with Chronic Nephritis.

By H. A. T. Fairbank, M.S.

D. W., aged 13. Complaint: Bowing of legs one year.

History: No history of rickets in early childhood; no rickets in family; no deformities in family; general health apparently good. Became nervous two years ago, with pain in loins. Her doctor blistered her back; he thought it was a cold at the time. Mother had some tonsillitis and influenza just before the child was born. No history of trauma to the legs.

On examination: Height 4 ft. 9 in. (only ¾ in. below the average). There is a genu varum affecting both legs, the curve taking place principally in the tibiæ, just below the upper extremities. The lower epiphyses of both tibiæ and fibulæ are somewhat enlarged. The right leg is ⅝ in. shorter than the left, the shortening involving all portions of the leg. Nothing else abnormal in the legs, except that flexion is slightly limited in the right hip, and the right thigh cannot be carried across the abdomen. The upper limbs are normal except for the forearms which are both shorter than normal. Both bones of the forearms are curved, the radius outwards, the ulna backwards, and the distal portions are slightly enlarged. There is limitation of pronation and supination, particularly the latter, on both sides. There is some limitation of movements in the wrist joints in the direction of flexion and abduction. There is no beading of the ribs. The spine is normal. Examination of the body for sepsis is negative. The tonsils are small, and sepsis, if present at all, is of the very mildest type. There is only one gland to be felt in the neck. The spleen is not palpable. Urine: A catheter specimen showed a trace of albumin and a few granular casts. There is no globulin present. Culture sterile.

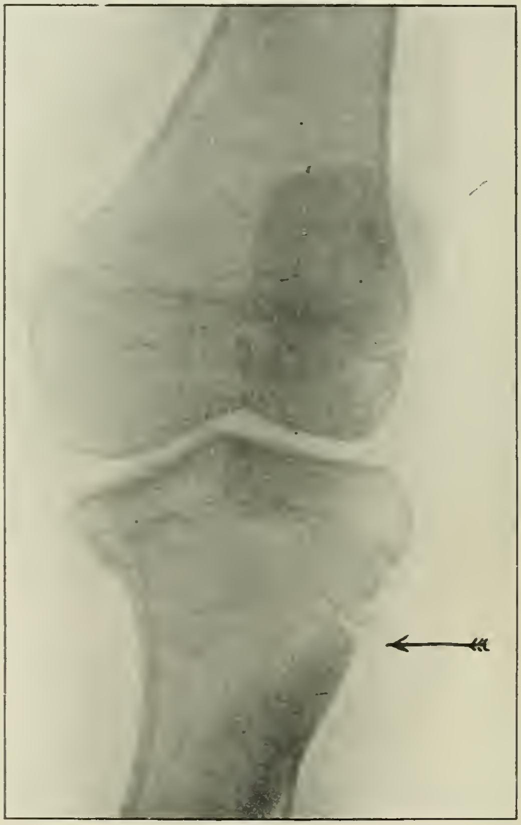


Fig. 1.

Case of deformity associated with chronic nephritis. Both knee-joints showed the same appearance in the tibia.

Blood examination: Red cells, 5,583,000 per cubic millimetre, 111·6 per cent. of normal, normal in size and shape; hæmoglobin, 86 per cent.; colour index, 0·77; leucocytes, 8,000 per cubic millimetre; polynuclear, 53 per cent.; lymphocytes, 46 per cent.; large mononuclear, 1 per cent.; no unusual cells.

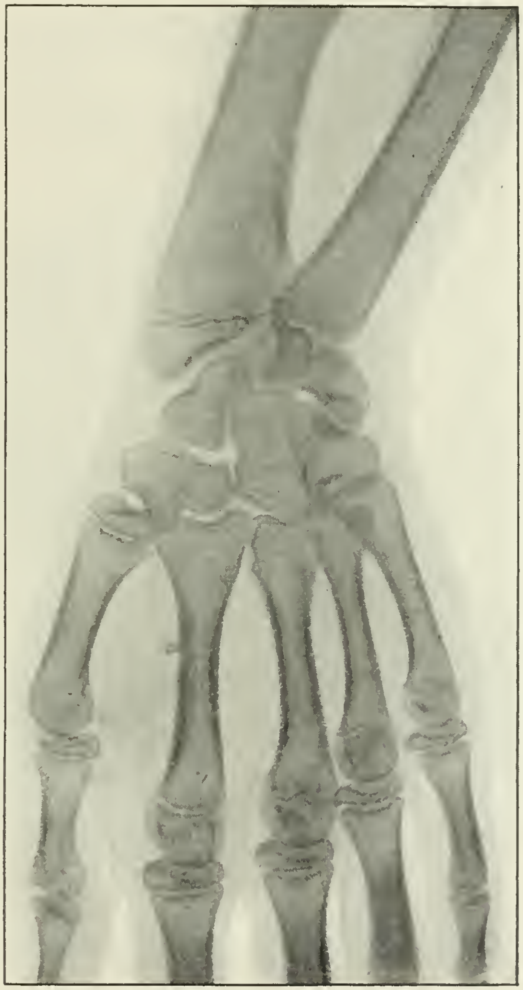


FIG. 2.

Case of deformity associated with chronic nephritis. The two forearms were precisely similar in appearance.

X-ray examination shows some distortion of upper epiphysis of tibia, and a fairly abrupt curve in the juxta-epiphyseal region of the shaft, accounting for the varum. On each side there is a crack running into the shaft on the outer side for ¾ in. or so. These cracks are nearly parallel to the adjacent portion of the epiphyseal line, and distant from it ½ in. in one leg, and ¾ in. in the other. In the lateral views the position of the crack shows as a fine dense transverse line. The hips and pelvis show no abnormality. There is no sign of rickets. The radius, in both forearms, shows a fairly abrupt curve, convex outwards, at the junction of the middle and lower thirds, with some diffuse thickening. The ulna has a less marked and more gradual curve, convex backwards, the lower end being displaced somewhat forwards, in front of, and overlapping, the carpus. The epiphyseal lines are sharp and narrow, but somewhat irregular. The radial epiphysis is distinctly wedge-shaped with the base outwards, the carpus being pushed over towards the ulna, so that the two overlap, the ulna in front and the carpus behind. There is no definite obliteration of the inner part of the radial epiphyseal line, and the radius is not short, so the appearances do not quite agree with that seen in Madelung's deformity, while of course the position of the ulna is different. The lateral views show the carpus displaced on to the posterior lip of the radial articular surface.

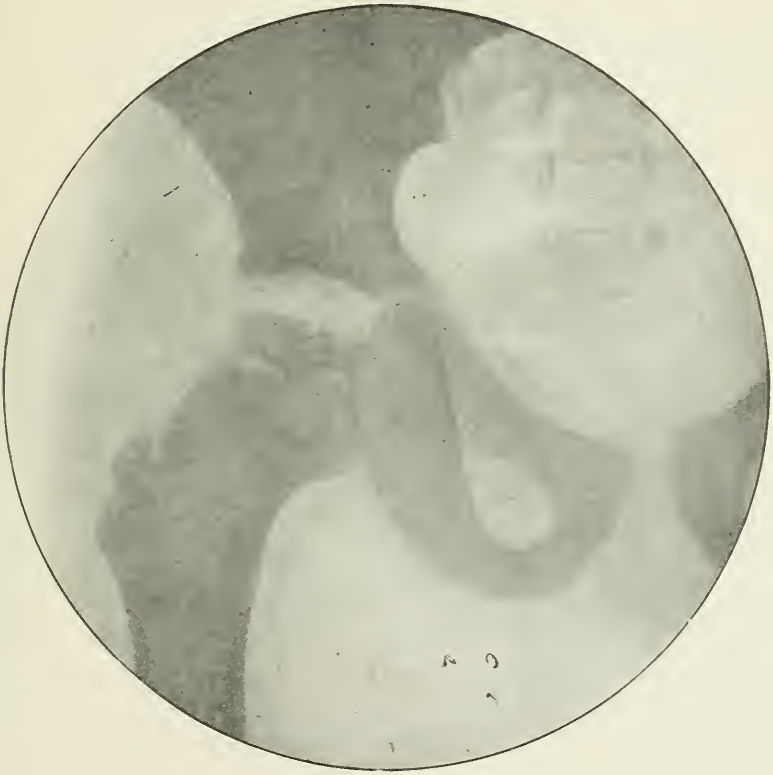
Pseudo-coxalgie.

By H. A. T. Fairbank, M.S.

R. P., aged 8. Four months ago he was knocked down by a bicycle, and the rider fell on him. The left foot was bruised. One month after the accident he began to limp on the left leg, and has complained of some pain in that leg. Limp getting worse.

On examination: A healthy looking child, perhaps rather undersized. He limps on left leg. Legs are equal in length; slight wasting of left thigh; marked limitation of abduction of that hip with some limitation of internal and external rotation, but flexion is free, almost to the extreme limit. Extension is obliterated. The trochanter is normal in position, and there is little, if any, thickening in the region of the head and neck of the femur. No pain on percussion. Trendelenburg's sign is positive. The left foot is slightly shorter than the right. Von Pirquet reaction is negative. Wassermann reaction doubtful, probably weakly positive. No source of possible infection found. There is a systolic murmur, ? mitral disease. Urine: Negative to examination.

X-ray examination shows typical changes indicating pseudo-coxalgie. The head centre of the femur is flattened and irregular, the epiphyseal line is irregular, and there are two clear spots, close together, with a sharply defined dense wall, in the neck of the bone near the centre of the epiphyseal line, but separated from it by ¼ in. of normal bone. The acetabulum shows some irregularity of surface. The neck of the femur is slightly thickened. There is asymmetry of the pelvis, the left side being smaller.



Case of pseudo-coxalgie.

The range of movements has slightly increased with the few days' rest since admission to hospital, but there is now some slight fixed flexion. Opinions are invited as to what the clear spaces in the neck really are. They appear to be far too sharply defined—with a thin shell of condensed bone around—to be due to tubercle or other inflammatory process. A walking calliper splint has been ordered for the boy.

Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.

President—Mr. E. Laming Evans, C.B.E., F.R.C.S.

Multiple Congenital Dislocations.[1]

By E. Laming Evans, C.B.E., F.R.C.S. (President).

J. W. shows a condition of congenital dislocation of the knees with associated deformities at the elbows, hips and ankles. Such cases are not infrequently seen in infancy, but it is then not always clear whether the case is one of congenital dislocation or of genu recurvatum : a case of congenital dislocation in an untreated condition is certainly very rare at the age of 15. In this case, some attempts have evidently been made to correct the equino-varus condition of the feet by subcutaneous tenotomy, but with only a slight success upon the left side. No history is obtainable. The boy is aged 15, and stands 44 in. high. He is somewhat backward, somnolent but good-natured. He can stand and walk short distances without help, but his normal mode of progression is by means of crutches. In the standing position there is a posterior projection of the ham region through an angle of 40° to 50°, and this is caused by the upward and forward dislocation of the tibia, the salient point of the angle being the two femoral condyles. The X-ray shows that the joint is locked by contact of the posterior surface of the tibial condyles against the anterior surface of the femoral shaft above the normal cartilaginous surface for the patella. When the patient is in the recumbent position the whole limb is rotated outwards at the hip-joint, and gives the case the appearance of a valgoid condition, but the two femoral condyles can be clearly felt upon the inner side. The patella is present on both sides: on attempting to flex, the movement is checked at 5° of hyperextension by the shortening of all the structures in the front of the joint. The hip-joints show shallow acetabula. On the left side one-quarter of the head only is covered by the acetabular roof; on the right side one-third is covered. Both femoral heads can be subluxated by manipulation. The heads of both radii are dislocated forwards and upwards.

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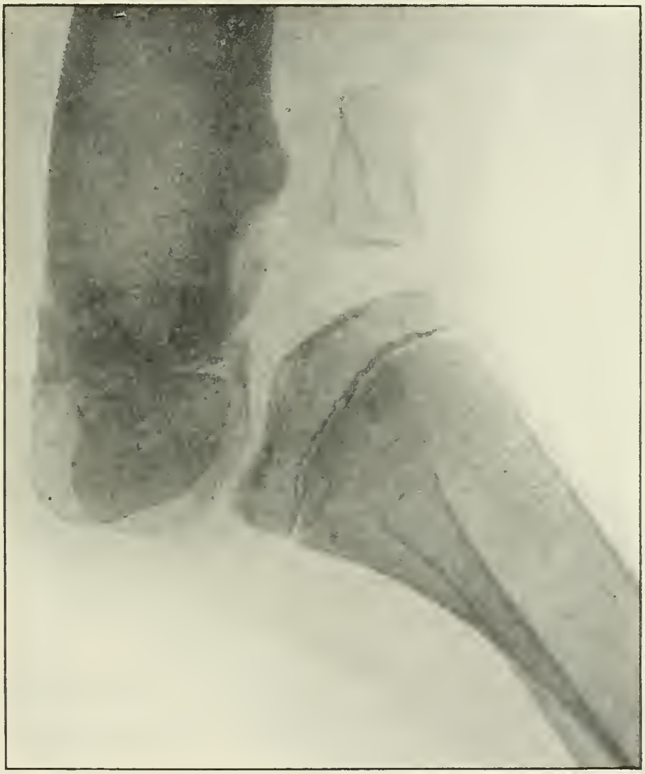
[1] At a meeting of the Sub-section, held November 2, 1920.



Case of multiple congenital dislocations. Lateral view of right knee-joint in case of J. W.

It is proposed, after obtaining plantigrade feet, to treat the case by excision of the knee-joints.

Mr. ELMSLIE considered excision of the knee-joints to be the best method of treatment in order to obtain ankylosis. Considering the age he would not attempt to obtain a movable knee-joint.

Further Report on a Case of Cyst of the Head of the Tibia.

By R. C. Elmslie, M.S., F.R.C.S.

I showed this case at the meeting held on March 2, 1920. At the operation a vertical incision was made and the periosteum and attachments of sartorius, &c., stripped back. The thin anterior layer of bone was removed and a cavity opened which contained brown fluid. It was traversed by a bony shelf and by some smaller bony trabeculæ. There were no solid contents; the walls for the most part consisted of bare bone, but in places this was covered by a grey membrane. The interior of the cavity was thoroughly curetted, and the antero-external wall was crushed in. The periosteum and skin were sutured and the leg enclosed in plaster of Paris for protection.

Microscopic examination showed that the bone around the cyst was normal, only showing a few signs of absorption (Howship's lacunæ and osteoclasts). The marrow in this bone was normal. The grey membrane consisted of fibrous tissue, in parts well formed, in parts very vascular and cellular. It did not contain giant cells, or at any rate these were not a conspicuous feature. In some places there were traces of a very cellular tissue which lay on the inner side of the fibrous membrane; this consisted of small round cells and was very vascular, the vessels being fully formed. Most of the solid matter obtained from the interior of the cyst proved to be blood clot.

Discussion on Mr. H. A. T. Fairbank's Case of Deformities associated with Chronic Nephritis.[1]

Mr. Fairbank recalled the chief facts of interest in the case, and said that a considerable number of cases of renal disease associated with infantilism and with infantilism plus deformities were to be found in the medical literature, particularly in recent years. This case was exceptional in that the child was of normal stature. Distinction had been made in these cases between those with deformities and those without, and also between those with symptoms at birth, and those in which symptoms had developed later. The bone changes are usually described as being similar to rickets, Hutinel says midway between rickets and osteomalacia. Paterson reported three cases at the Children's Section in April this year, together with the pathological findings.[1] Mr. Fairbank had the opportunity of examining one of these cases. The feature of the X-ray findings in his cases (the ages being 11, 1½ and 7½), consisted in multiple fractures in the juxta-epiphyseal region of the long bones, while the microscopic section of the diaphyseal bone in this region showed deficient calcification and irregular ossification somewhat similar to rickets, but the epiphyseal lines were straight. In the case shown the X-ray appearances were quite unlike rickets. Were the cracks in the tibiæ in this case the first signs of a juxta-epiphyseal fracture which would gradually spread till complete? It was noteworthy that in Paterson's cases nothing was said of the children having suffered from clinical fractures, though the X-ray revealed that such had occurred. The deformities seen in the forearms in this case had not, he thought, been described as present in other reported cases. It might, of course, be contended that this case should not be classed with those previously reported since she was certainly not a dwarf. Knowledge of the rarer types of bone disease was so imperfect that it was to be hoped that no opportunity would be lost of investigating thoroughly every case not obviously due to rickets. All those cases which invited the name of continued or delayed rickets should be investigated by means of X-rays, complete examination of urine, blood, &c. Since the case was shown at the last meeting, he had discovered an interesting specimen in King's College Hospital Museum of a complete skeleton of an adult dwarf, of the male sex he believed, presenting many deformities of the long bones, and curiously short forearms not unlike the forearms in this case. The ulna was the shorter bone of the two, the radial articular surface being very oblique, as seen in the radiograms of this case. The case was also of interest in having maldevelopment and fusion of vertebræ in the upper dorsal region and in the lower lumbar and lumbosacral region.

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[1] Case shown at the meeting held on October 5, 1920 (*see* p. 21).

Dr. D. H. PATERSON considered Mr. Fairbank's case to be of the type described by Dr. Morley Fletcher, Dr. Hugh Barber and Dr. H. C. Cameron—namely fracture deformities of the limbs associated with chronic interstitial nephritis. Dr. Hugh Barber had described the changes as similar to rickets and Dr. Cameron thought the changes similar to osteomalacia. He (Dr. Paterson) would merely describe the microscopic pathology of the condition from sections obtained post mortem. The fractures were usually multiple and on the diaphyseal side of the epiphyseal lines. In the younger children there was a curious stippled appearance in the radiograms where callus had been thrown out at the site of the fracture. The epiphyseal line, unlike that in rickets, was usually straight. The feature of the sections was the absence of bone forming activity, and the trabeculæ, which were abundant, were composed of connective tissue in which there had been no deposit of lime salts. This absence of osteoid tissue tended to the production of fractures on slight strain.

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[1] *Proceedings*, 1920, xiii (Sect. Study Dis. Child.), p. 107.

A number of cases already reported had been operated on for their deformities and later had died of uræmia. The practical lesson, therefore, was the necessity for careful examination of the urine of all children and young adults brought to orthopædic surgeons for operations for multiple deformities, in order to avoid a possible fatal issue.

Mr. ELMSLIE suggested that the appearances shown in the skiagrams of the knee-joints might be due to the overlapping of the upper epiphysis of the tibia, the lower edge of which looked like a crack.

Mr. FAIRBANK, in reply, thanked Dr. Paterson for his interesting remarks and said he could not accept Mr. Elmslie's explanation of the cracks in the tibia. These cracks were seen as lines in the lateral views of the knee-joints, well below the level of the epiphyseal lines.

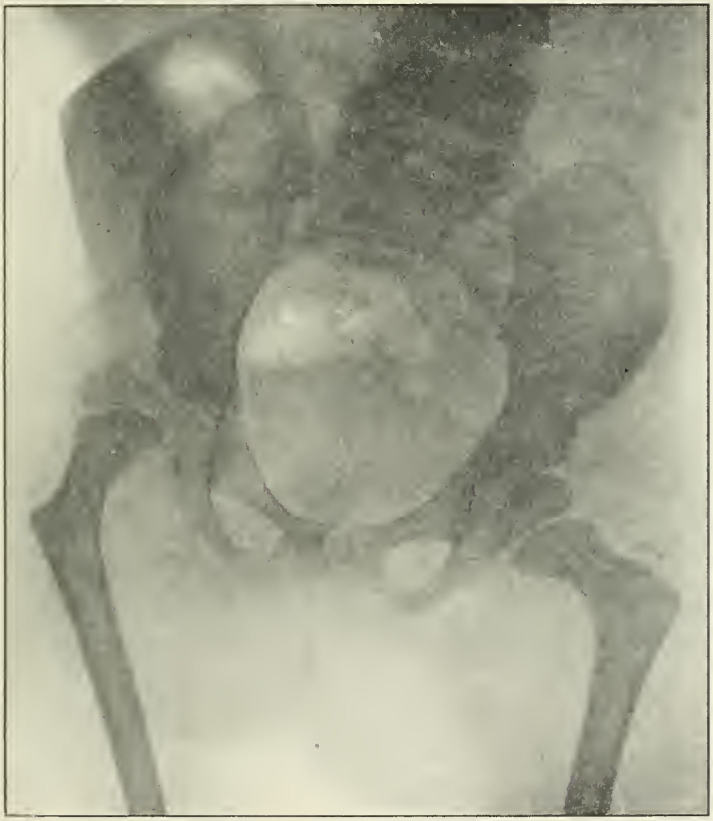
Case of Paralytic Subluxation of Hip with Paralysis of Adductors.

By H. A. T. FAIRBANK, M.S.

G. F., FEMALE, aged 4. Attack of poliomyelitis at the age of 4 months. Has never walked, but can sit up. She lies with the pelvis tilted up on the right side. There is a lumbar curve to left with well marked rotation. There is some bulging in the left loin due to weakness of abdominal muscles on that side. The right leg seems to be completely paralysed including all muscles about the hip joint with the possible exception of the rectus femoris. The head of the femur is subluxated on the upper lip of the acetabulum, but can be restored to its normal position with a definite slight snap. Adduction is slightly limited as compared with the other side, but abduction is excessive. There is no response to faradism in any muscles of the right leg. The ankle is flail. The left leg is also severely affected, but the adductor longus is the only adductor acting. The hamstrings and gastrocnemius are acting. There was an equino-varus which is now in process of correction. Radiograms of the right hip agree with the diagnosis of paralytic subluxation. There is nothing to suggest that the displacement is congenital in origin. Both erector spinæ muscles react to faradism.

The case is shown on account of the rarity of paralytic dislocation of the hip, and more particularly because the displacement in this case seems to have occurred without adequate cause. The few similar cases I have seen have all shown active adductor muscles and weak or paralysed abductors. Except for the habitual position of adduction in this case there seems to be nothing to account for the displacement, the paralysis being so complete.

I have here the skiagrams of another case of paralytic subluxation of the hip-joint, a girl aged 14. In this case the adductors are active and the abductors paralysed.



Case of paralytic subluxation of the hip, with paralysis of the adductors.

Internal Derangement of the Right Knee-joint in a Boy, aged 8.

By B. Whitchurch Howell, F.R.C.S.

A. G., MALE, aged 8, on August 18, 1920, was playing with a cart wheel, which flew off its axle, and hit the child, on the front of the right thigh, above the patella. Much synovitis followed. He was treated at the

Queen's Hospital for Children, Hackney Road, by a compression bandage and gutter splint. When the fluid had subsided it was discovered he could not get his knee dead straight, and any attempt to do so passively was painful, especially behind and on each side of the ligamentum patellæ. Here the tissues were thickened. There was no abnormal mobility.

Range of movement: Full flexion, but about 10° short of complete extension; slight creak on attempting dead extension; slight limp, and pain behind the ligamentum patellæ on jumping.

X-ray: Injury to bone of fore part of tibial plateau, chiefly in the middle line; suggestive of loose body, discoid in shape.

Opinions asked (1) as to exact nature of injury; (2) best line of treatment.

DISCUSSION.

Mr. MUIRHEAD LITTLE suggested splintage to get complete extension.

Mr. ROWLEY BRISTOW advised treatment on the same lines as for bruised infra-patellar pad of fat, namely, raising the heel and using a knee-cage to prevent attempts at full extension for a time.

Mr. ELMSLIE entirely disagreed with Mr Bristow's opinion as he thought the treatment suggested would certainly lead to persistence of the limitation of extension of the joint. He advocated straightening the leg under an anæsthetic and fixation in the fully extended position.

Mr. HOWELL (in reply) said he felt it was a bony block which could only be removed by operation. Splintage had already been tried.

Section of Surgery.

President—Mr. Walter G. Spencer, O.B.E., M.S.

EXHIBITION OF SPECIMENS OF RARE AND INTERESTING TUMOURS OF THE BREAST.[1]

CATALOGUE OF EXHIBITS.

St. Bartholomew's Museum.

By L. Bathe Rawling, M.S.

Fibro-adenoma, undergoing Carcinomatous Degeneration.

3159 C. The tumour is encapsuled and is seen lying amid healthy breast tissue. Its cut surface is greyish and semi-translucent, reticulated with delicate fibrous strands. Centrally, there is seen an area which is white and more opaque, and into which hæmorrhage has occurred. The margin of this central patch is not everywhere sharply defined.

Microscopical Examination.—Main tumour—fibro-adenoma. Central mass—spheroidal-celled carcinoma which can be seen infiltrating the primary growth.

Perithelioma of the Breast.

3164 C. A breast with part of the pectoralis major, and a mass of glands and tissue from the axilla. In the outer and upper quadrant of the breast is a malignant tumour, with some hæmorrhages in its substance. In the axillary tissues is a large mass which consists of growth fairly sharply marked off from the tissue of the breast, in which are a number of irregular necrotic areas. The pectoralis major is invaded by the lower part of the secondary deposit.

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[1] At a meeting of the Section, held December 1, 1920.

Microscopical Examination.—Growth consists of cellular collections singly or coalescing into larger areas, but separated from one another by areas of necrosis, in which cellular arrangement and nuclear staining are indistinct. The cells are of various types, from round cells to cells of a larger kind with processes, and arranged for the most part radially round spaces, some of which contain blood corpuscles. The lining of these spaces appears to consist of the cells which make up the growth, though here and there a capillary vessel can be seen. The tumour is probably a perithelioma.

Paget's Disease of the Nipple.

3181 K. A breast showing the ulcerated condition of areola and nipple, known as Paget's disease. The nipple is much reduced in size by the ulcerative process. A band of tissue, tough to the knife, leads directly backwards from the nipple, along the course of the lactiferous ducts, to a mass of similar tissue deeper in the breast. Numerous vacuolated cells are present in the ulcerated area of the dermis, with desquamation of the cells of the superficial layer. When more marked ulceration is present the superficial cells have gone, and the tissues are infiltrated with round cells, and the cells lining the ducts are proliferating. Farther from the surface the ducts are plugged with proliferating cells assuming a malignant character. There appears no evidence of malignancy in the deeper mass, but areas of chronic interstitial mastitis are present.

Fibro-adenoma and Carcinoma of the same Breast.

3159 D. A breast showing two small tumours. That close to and a little to the outer side of the nipple is a fibro-adenoma; the other is a scirrhous carcinoma.

Osteo-chondro-sarcoma.

3162 C. Embedded in the periphery of the breast is an oval bony and cartilaginous mass, measuring 2 in. by $1\frac{3}{4}$ in. It is not definitely encapsuled, for calcareous, though soft, projections from it infiltrate the surrounding tissues, including the pectoralis major muscle. Its surface is mottled red and white, the red areas resembling cancellous bone, the white areas cartilage. The softer parts of the growth are spindle-celled sarcoma. These are mingled with areas of cartilage undergoing calcification and also with areas of true bone.

Chronic Mastitis with Cysts.

3146. A left breast in which are several cysts of various sizes. The cysts are embedded in a fibrous matrix which has replaced the original breast tissue. In the fresh state the whole organ was tough to the knife, and the cysts contained serous, or slightly turbid fluid, which deposited a fibrinous coagulum on being hardened. The skin is not attached to the deeper structures and the nipple is not retracted.

Microscopical Examination.—The breast shows the characters of chronic interstitial mastitis in which are many spaces, some of which appear to be dilated lactiferous tubules, others being much larger. The lining epithelium of the larger cystic spaces is generally a single layer of cells, but in some places more than a single layer is seen, and here and there small papillomatous growths are present.

Galactocele.

3145 A. A tumour of a breast, consisting of a spherical encapsuled mass of caseous material of a yellowish colour, surrounded by a fibrous and fatty tissue. The contents consist of the inspissated secretion of the breast.

Duct Papilloma of the Breast.

3146 B2. A breast showing a cavity which in the recent state was filled with blood, with a whitish growth projecting into its upper part. The growth is circumscribed though no actual capsule is to be seen. The cyst is lined with a brownish membrane, stained by the blood which had filled it.

Microscopical Examination.—The tumour is made up of branching epithelial projections, on a slender fibrous framework, and shows no evidence of malignancy. It is a duct papilloma.

Charing Cross Hospital Museum.

By H. S. Clogg, M.S.

Round-cell Sarcoma of Breast.

A slice from a breast, showing a large soft hæmorrhagic growth, occupying its centre, extending from the nipple back to the pectoral fascia, presenting a soft brain-like appearance ; the most anterior portion of it growing into the nipple itself—protruding, not retracting it. The skin over the most projecting portion is thinned out, but it is nowhere involved in the underlying growth. The edges of this are everywhere sharply defined from the surrounding breast tissue. Extensive hæmorrhage has occurred into the centre of the growth, the central part consisting of what appears to be blood clot, but in reality is made up of the soft growth into which hæmorrhage has occurred.

Microscopically.—The growth is a well marked round-cell sarcoma.

Adeno-carcinoma of Male Breast.

One half of the breast, showing a well-defined mass of growth, immediately subjacent to the nipple, which is invaded by the growth, and slightly retracted ; the skin is invaded. The growth is an adeno-carcinoma.

St. George's Hospital Museum.

By Ivor Back, F.R.C.S.

(1) Hæmorrhagic Duct Carcinoma of Breast.

(2) Carcinoma of Male Breast.

(3) Colloid Carcinoma Mammæ.

(4) "This is probably a Duct Papilloma."

The tumour is composed of a large cyst with a stout wall of fibrous tissue about one-twentieth of an inch thick. One half of its circumference is covered by the integuments and the other half by compressed fat. The nipple is on one side of the tumour and is retracted in the spirit-kept preparation. There is no morbid growth outside the cyst, but under the nipple for a breadth of 2 in. the cyst wall is separated into layers, between which masses of growth of the same kind as those within the cyst cavity are insinuated. The cavity is large enough to contain about one pint of liquid. Into it from the wall enormous numbers of short, close set, polypoid growths project, lining the interior almost completely, the incompleteness being in the part of the cyst corresponding to the skin where some square inches are without these growths. The growths are of two forms, one kind being rounded, and attached by half the circumference; the other dendritic, finely branched at the free end, and attached by a slender stem. They vary in length from a projection of an inch to a scarcely visible minuteness. Forms intermediate between the dendritic and rounded growths are present. Upon cutting the sections through the rounded growths they are found to be composed of a vacuolated substance, the walls of the little spaces being made up of a fibrillated tissue in which cells are embedded, the spaces containing an epithelial formation which is defaced by the action of spirit, but can be seen to have been composed of comparatively large elements. This epithelium is detached from the walls of the spaces and lies somewhat irregularly, but appears to have formed a lining to the spaces. Some of these spaces are elongated, others rounded. In parts of the section the spaces are few or absent, and the substance which forms their walls is present in quantity. The substance in such parts no longer has the appearance of close set fibrillar tissue with flattened cells but is seen as a fine web of exceedingly delicate fibrils, in which large caudate cells are embedded. These cells communicate together by their sharp branches and by their small branches are attached to the embedding fibril work.

These characters may be summed up by describing the tumour as an adenoid growth within a tissue, the substance of which is fibro-cellular, complicated by the formation of a large cyst, into which, as in the direction of least resistance, the lobules of the tumour grow in the form of polypoid projections. (Report of the Committee of Morbid Growths, of the Pathological Society.)

The tumour was removed, by Mr. Prescott Hewett, from a woman, aged 40. It had appeared eighteen years previously and had grown rapidly at first. The patient had been in the habit of tapping it with a pen-knife about once every six months, drawing off a quantity of clear limpid fluid on each occasion. The operation was performed in consequence of an increased rapidity in filling which the tumour began to display, coupled with a decline of the general health. The patient made a good recovery, and no recurrence of the growth took place; but five years later the axillary glands of the same side enlarged rapidly and were found to be affected with carcinoma.[1]

St. Thomas's Hospital Museum.

By Cyril Nitch, M.S.

Cystic Adeno-fibroma of Breast.

2521. A breast which is the seat of a large cystic adeno-fibroma. The integument, with the walls of the subjacent cysts, has given way and allows the coarsely lobulated intracystic growths, which have undergone no notable change, to project. The tumour is quite circumscribed and can be isolated from the surrounding tissues.

Round-celled Sarcoma of Breast undergoing Fatty Degeneration.

2521 D. A slice from a large malignant tumour of the breast. The new growth is a pronounced construction of spheroidal lobules parted by connective tissue which have an unusual opacity and whiteness. Histologically, it is a round-celled sarcoma. In sections stained with scharlach, a remarkable amount of fatty change is disclosed; the degeneration affects the tumour cells in almost every part, and in some areas the cells have quite disappeared, the material consisting of a mesh filled with droplets of fat. Some of the elongated connective tissue cells in the stroma likewise hold fat. In the upper end of the specimen there is a cyst, filled with intracystic growths. Microscopically, these growths present the usual simple structure of connective tissue, but in the centre of some of the processes there are groups of unilocular fat cells, with peripherally disposed and flattened nuclei. Judging from the history, the tumour seems to have been benign at the outset, and later, to have furnished the starting point of a sarcoma. The amount of fat degeneration is unusual and striking and its extension is obscure. Death occurred about eighteen months after the operation with signs of secondary growths in the lungs.

Carcinoma of Breast—Metastasis in Vertebræ.

667. Vertical and horizontal sections of the bodies of some of the vertebræ. The osseous tissue has been replaced in numerous situations by growths of a firm infiltrating new growth, which microscopically presents the typical appearance of a spheroidal-celled carcinoma of the breast.

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[1] *Trans. Path. Soc. Lond.*, xx, p. 347.

Carcinoma of Breast—"Paget's Eczema."

2534 B. A vertical section of the breast, the areola of which was the seat of chronic eczema, the condition being diagnosed as "Paget's disease." The corium beneath the eczematous area is distinctly thickened, but to the naked eye nothing is discernible except fibrous tissue. A short distance beneath this there is a radiating, translucent area in the breast, in which a certain number of minute spaces filled with an opaque material may be seen. Microscopic examination of the mammary lesion and skin shows it to be an atrophic, spheroidal-celled carcinoma.

Diffuse Carcinoma intermingled with Functionating Gland.

2527 A. A slice from a breast, showing diffuse infiltration with a carcinomatous growth. The ducts are, in places, filled with translucent coagulum, in which are included opaque pellets of inspissated fat (from milk). Microscopic examination shows the carcinoma to be of the spheroidal-celled kind, closely intermingled with glandular acini which are actively functionating, the epithelial cells being loaded with fat. The transitions from the normal to the morbid cell-groups are readily traceable; in the latter, however, a few only of the cells contain fat. The breast was removed from a woman, aged 39, who had had a child (her sixth) five weeks previously. The patient had noticed a growing swelling in the breast for two months. She had used the breast for suckling all her children except the last.

Multiple Duct Papillomata of Breast.

2515 A. A slice from the breast of a girl, aged 15. In it there are a certain number of sharply-defined, spheroidal tumours, which have a closely set papillary construction, and are papillomata which have grown into the ducts.

Very early Carcinoma of Breast.

2522 E. A small portion of a breast, with the overlying skin and subcutaneous fat. Embedded in an outlying extension of the breast there is a scirrhous carcinoma, not larger than a pea. Above it there is suspended a section of the axillary fat, included in which may be seen a group of lymphatic glands. Two lymphatic glands, moreover, have been dissected out and shown separately. None of these is obviously enlarged, and a microscopic examination of two of the larger did not reveal any secondary carcinomatous infection.

Spindle-celled Adeno-sarcoma of Breast.

2521 C. Half of a spheroidal tumour from the breast, about 2½ in. in diameter. In section it has an ill-defined lobulation, and in some places is translucent, like mucous tissue. Microscopic examination shows the tumour to be a spindle-celled adeno-sarcoma; processes of the spindle-celled tissue project into, and distend, the ducts. In places the stroma is that found in adeno-fibromata, and the malignant disease has probably arisen in a pre-existing benign neoplasm.

Carcinoma of Breast with Extensive Metastasis.

2525 C. A vertical section of a breast which is much enlarged by the growth of a diffuse carcinoma. At the lowest part of the specimen the tumour has extended through the subcutaneous fat, and has commenced to invade the skin. On the deep aspect it has reached the surface of the pectoralis major. Portion of the muscle which has been removed with the breast is thickly strewn throughout its substance with carcinomatous nodules. Death occurred about six weeks after the operation. At the autopsy metastases were found in the lungs.

Columnar-celled Carcinoma of Nipple.

2531 B. A vertical section of a nipple with the subjacent part of the breast. The nipple is considerably enlarged by the growth of what microscopic examination shows to be a typical columnar-celled carcinoma.

From the Museum of University College Hospital.

By Raymond Johnson, O.B.E., F.R.C.S.

Lobulated Intracystic Fibroma of Breast.

2242. The cyst, which has a smooth lining, has been opened to display a mass of intracystic growth by which it was almost completely filled.

Microscopic.—The surface of the intracystic growths is covered by several layers of epithelial cells, the deepest cubical, the superficial spheroidal. The substance of the growth is composed of cellular fibrous tissue.

Pure Adenoma of the Breast.

2244. The tumour is 12 cm. in diameter; its surface slightly lobulated and enclosed in a loose capsule. The section shows small closely packed lobules bound together by fairly abundant fibrous stroma.

Microscopic.—Groups of acini lined with epithelium : small ducts connected with these, but a total absence of large ducts.

Endothelioma of Breast.

2276. The tumour measures 14 cm. in width : it is soft, composed of numerous lobules and surrounded by a capsule of delicate connective tissue. The skin is not implicated and the tumour is readily separable from the breast tissue.

Microscopic.—The tumour consists of narrow, elongated, solid columns of polyhedral cells. The columns are separated by a very delicate stroma consisting for the most part of two or three fibrils of connective tissue enclosing a thin-walled blood-vessel.

Carcinoma and Fibro-adenoma of Breast.

2309. The carcinoma involves the whole thickness of the gland. Partly embedded in the deep aspect of the growth is a small encapsuled fibro-adenoma.

Duct Papilloma and Carcinoma of Breast.

2311. There is a small cyst on the deep aspect of the breast, containing a delicately papillary growth. The breast tissue around is condensed and several minute cysts can be seen on the cut surface, but there is no definite evidence of growth to the naked eye.

Microscopic.—The tissues around the cyst show the structure of spheroidal-cell carcinoma.

Clinical.—The breast was excised. Four years later recurrence occurred in the scar, the growth being colloid carcinoma. Death occurred three years later: secondary deposits were present in the sternum, liver, lungs and skull, those in the lungs and skull being colloid.

Squamous Carcinoma of Breast.

2320 A. The central opaque tumour-substance extends into the breast for 7 cm. beneath a small ulcer of the skin, from which the growth appears to have arisen. The central part of the tumour is broken down by suppuration. The nipple is normal.

Microscopic.—The tumour is a squamous carcinoma. The axillary glands contained growth.

Clinical.—A married woman, aged 50, had noticed a lump for four months. An abscess formed in the tumour and discharged through the skin.

Squamous Epithelial Tumour of Breast.

2267 A. The tumour measures 5 cm. in length; it had a fibroid appearance on section, with irregular opaque white areas: its outline is well defined, but intimately connected with the surrounding breast-tissue.

Microscopic.—Irregular masses of stratified squamous epithelium with well developed prickle cells. Interspersed among these are irregular gland-like spaces lined with spheroidal epithelium in layers of two or three cells. In some places a direct transition from these cells to the squamous masses is evident. The fibrous stroma contains islands of fat and breast-tissue. Axillary glands normal.

From the Museum of the Westminster Hospital Medical School.

By W. G. Spencer, O.B.E., M.S.

Affections in the Immediate Vicinity of the Nipple.

1100 A. *Inflammatory Condition of the Nipple simulating Paget's Disease.*—A portion of the breast with the nipple, which is prominent from infiltration of the tissues, which extend for about ¾ in. round it. From a woman, aged 40, who had had the condition for ten weeks, and who only consulted the surgeon because of recent oozing and bleeding. In the natural state the condition exactly resembled Paget's disease, but the action of the various fluids used in preparation of the specimen has been to dull the bright red areola surrounding the nipple, and to cause the once flattened-out nipple to become prominent.

1129 A. *Cancerous Ulcer in the Immediate Vicinity of the Nipple.*—Breast with skin and nipple; to the outside of the latter is seen an ulcer. This ulcer has partly the histology of an ordinary squamous carcinoma, and partly a typical rodent cancer. From a woman, aged 58, who had had the ulcer for eighteen months. It was said to have started in a supernumerary nipple. The axillary glands were large, but were not affected with secondary deposits.

1129 B. *Rodent Ulcer in the Vicinity of the Nipple.*—Breast with nipple, to one side of which is an ulcer. This is histologically a typical rodent cancer. From a woman, aged 74, in whom it had been present five years. No involvement of deep structures.

1101. *Papillomatous Mass in Immediate Relation to the Nipple.*—A papillomatous mass removed from just beside the nipple of a woman, aged 37. It had been present since the age of 16. The patient had had several pregnancies, but had never had any milk in this breast, though it swelled up at each period.

Some Tumours in connexion with the Ducts.

1104. *A Galactocele.*—A good example of this condition.

1114. *Intra-duct Papilloma.*—A breast in which the organ has been converted into a series of intercommunicating cysts, the largest of which contains a large papillomatous growth. The cells covering the papilloma are for the most part short columnar in type. Age of patient not stated in the history of the case.

1115. *Intra-duct Papilloma and Carcinoma.*—A breast the seat of a cystic tumour which is seen to be filled with a papillomatous growth. For the most part this growth is a benign papilloma, but there are places where it is undoubtedly a carcinoma. From a woman aged 44, who had had four children, the last eleven years previously. At this pregnancy she noticed that this breast did not secrete any milk. After this she noticed that there was an intermittent odourless discharge from the nipple about every three or four weeks. A swelling was noticed seven years ago, but only in the last three or four months had the swelling increased in size. No infected glands were found.

1108 A. *Peri- and Intra-duct Fibroma.*—A good example of a well marked case of peri-canalicular fibroma involving the whole breast. Owing to the action of the various preserving fluids on the fibrous tissue, much shrinkage has occurred, as the breast in the natural state was a very striking promontory on the chest of the patient, on whom it had been slowly growing for eighteen months. The patient was aged 42. The cut surface shows the typical "cut cabbage" appearance.

17/1564. *Peri-canalicular Fibroma into which a Hæmorrhage has occurred.*—An example of a localized peri- and intra-canalicular fibroma into which an extensive hæmorrhage has occurred. From a woman, aged 46, who for fifteen months had noticed a small lump in the right breast. Two weeks before admission the swelling suddenly became larger and very tender. Also a blood-stained discharge from the nipple occurred, which ceased before admission.

1109 A. *Bilateral Tumours of the Breast, peri-canalicular in Type.*—Two portions of breast, one from each side. From a young girl aged 14. Swellings in both breasts were noticed three months before admission, and these grew fairly rapidly. Histologically they are peri-canalicular fibromata, in which in addition there is considerable increase of the glandular secreting tissue.

Malignant Tumours.

17/643. *Adeno-Carcinoma undergoing "Colloid" Degeneration.*—A slice of breast showing a circular mass of growth which is undergoing "colloid" degeneration. The nipple shows marked retraction. From a woman, aged 78, who seven years before had noticed some discharge from the nipple. Two years after this a hæmorrhage occurred from this nipple, but no swelling was noticed until six months before admission. A swelling was then noticed to be growing with marked retraction of the nipple. Histologically an adeno-carcinoma of duct origin, undergoing "colloid" changes.

18/576. *Angeio-sarcoma of the Breast.*—Slices of breast showing a circular mass of growth of a dark purple-black marbled nature. One slice shows the nipples greatly retracted. From a woman, aged 74, of whom the notes have been entirely lost, so that the history is not known. Histologically it is composed of a groundwork of coarse fibrous trabeculæ from which arise finer fibrous strands. These strands are covered by short stumpy cells of mesoblastic type, in some cases almost short columnar. The cells generally speaking are arranged in the form of tubules and spaces filled with blood. The ordinary blood-vessels of the connective tissue are also present. An anomalous type of growth that should be classified as angeio-sarcoma.

Tumours of the Male Breast.

1106 A. *Fibrocystic Breast in a Boy aged* 8.—The swelling has been present for a year, and on tapping straw-coloured fluid escaped. There are no intracystic growths.

12/743. *Duct Carcinoma of the Breast in a Boy aged* 10.—History of a lump in the breast for two years. At first it was painful, but lately no pain has been felt. Histologically it has the arrangement of a duct carcinoma, malignancy degree doubtful.

1428 A. *Scirrhus of the Male Breast.*—The left breast of a male, aged 62. The nipple has been practically eaten away and replaced by a pink ulcerating area. Beneath this area is a mass fixed in life to the skin and pectorals. Glands in the axilla enlarged and contained secondary deposit. Growth is a spheroidal carcinoma of the "scirrhus" type. Said to have dated from an injury fifteen months previously, and to have been associated with occasional discharge of blood from the nipple.

Boling: *Scirrhus of the Male Breast.*—A similar specimen, only that the nipple had not been eaten away. The notes of this case give no further details.

London Temperance Hospital Museum.

By H. J. Paterson, C.B.E., M.C.

Gumma of Breast.

The half of a breast removed from a woman, aged 26, who had noticed a swelling in the right breast for three months. She was very anæmic, she had lost a good deal of flesh, but had had no pain. There was a densely hard swelling in the upper and outer quadrant of the right breast, with processes extending into the surrounding tissues. The swelling did not appear to be adherent to the skin or to the deep fascia. In the belief that the swelling was a sarcoma a Halsted's operation was performed, the glands in axilla being slightly enlarged. Microscopically, the growth was reported to be a sarcoma. Before the patient left hospital, several nodules appeared in the skin along the line of the incision as well as swelling in the axilla. Her anæmia was progressive, and it was thought that there was a rapid recurrence of the growth. She steadily became worse, and two months after she left hospital she returned with a diffuse swelling over the seventh rib in the mid-axillary line. This suggested a gummatous periostitis. She was put on mercury and potassium iodide, the swelling of the rib gradually disappeared, the nodules in the skin vanished, and after a few months she made a complete recovery. Re-examination of the specimen by several pathologists confirmed the view that the swelling was a gumma. She was quite well ten years after the operation and was then lost sight of.

From the Pathological Department of the Cancer Hospital.

83. Fibroma in a male breast.

56. Multiple cysts in chronic mastitis.

235. Carcinoma affecting almost the entire gland and infiltrating the areola. Beneath the nipple there is a large cyst across which run the galactophorous ducts.

117. The larger tumour is encapsuled. It is partly a lipoma and partly an adenoma, but there is no blending of the two structures. In addition, the breast contains a small carcinoma.

510. A duct carcinoma confined to the termination of the large ducts in the nipple.

794. Superficial warty epithelioma around the nipple.

887. A large cyst and a very cellular fibro-adenoma. It was found microscopically that the epithelium lining the dilated acini was in many places transformed into the squamous variety and the lumina were filled with horny material.

492. A papilliferous cyst-adenoma showing much hæmorrhage into the tissue. Histologically it appears benign. The axillary glands were free of deposit. Compare with next specimen 520.

520. An encapsuled tumour with much hæmorrhage. Histologically it was an adeno-carcinoma. The axillary glands showed cancerous deposit.

732. A malignant hæmangioma of the right breast. Recurrence of angioma in the scar, in the skin of the neck, and in the muscles of the left thigh. Spontaneous fracture of the left femur from secondary angioma. At autopsy deposits were found in left breast, in lungs, in liver, in left ovary, in the peritoneum, and under the skin of the abdominal wall.

769. Secondary nodules of angioma in left breast from the same case.

Specimen.

By Garnett Wright, F.R.C.S.

The patient was a woman, unmarried, aged 66. For many years she had had a lump in the left breast. She thought it had been there for at least ten years. Recently the lump had begun to enlarge and give her pain. On examination there was a very large nodular tumour in the left breast, increasing the size of the organ considerably. The skin covering it was not adherent, though thin and reddish in places. The tumour was not fixed to the muscle underneath, and there was no enlargement of the axillary glands. The tumour was considered to be a fibro-epithelial tumour which was probably becoming carcinomatous. In December, 1919, a radical breast operation was done. Microscopically, the tumour had the appearance of an intracystic papilloma.

Middlesex Hospital.

Epigastric Invasion of the Abdomen by Breast Cancer.—The parietal peritoneum of the upper part of the anterior abdominal wall in a case of breast cancer. The umbilicus is seen at the lower edge of the specimen. In the epigastric angle a mass of closely set cancerous nodules is seen on the peritoneum. Others follow the course of the round and falciform ligaments as far as the umbilicus.

2073 B. A section of a female breast showing multiple round and oval spaces containing masses of yellowish cheesy material. Some of these masses can be traced in the larger ducts converging to the nipple, while others much smaller can be seen in the terminal ramifications at the periphery of the breast. The nipple and skin over the breast are unaffected.

Microscopically the stroma is increased in amount, and contains gland alveoli and greatly dilated ducts. The ducts are filled with a non-cellular amorphous material (inspissated secretion).

2083 B. An encapsuled tumour removed from the breast. The specimen has been bisected and its contents are partly everted. It is a fibro-adenoma in the early stage which precedes the fusion of the apposed infolded adenomatous ridges. Later on these ridges lose their epithelium and fuse together. The tumour then becomes a solid mass containing only a few remaining chink-like spaces.

2079 B. Duct papilloma. A cyst from the breast due to dilatation of a duct, containing a small papilloma.

2079 C. A portion of a breast containing a large cyst. In the cyst is a flattened sessile growth. A smaller cyst with a similar growth is seen at the back of the specimen. Microscopically it presents the appearance of a papilloma, but at a few points in the section the epithelial cells are arranged somewhat irregularly and suggest early malignancy.

2079 D. Part of a breast containing a cyst filled to bursting point with masses of intracystic papillomata from a woman aged 68, figured in Sir John Bland-Sutton's "Tumours," 1917, page 325.

2087 A. A section of a female breast showing an adenoma. The adenoma is seen as an ovoid tumour completely encapsuled and lying in the upper half of the specimen. The nipple is inverted, but not retracted. The overlying skin is quite smooth and unaffected by the growth. From a spinster, aged 59, in whose breast the tumour had slowly been growing for thirty years.

"Tumours," 1917, p. 309. Presented by Sir John Bland-Sutton.

2095 A. A portion of a breast in section, the seat of a round-celled sarcoma. The tumour occupies the lower part of the breast below the nipple, it is rounded in form and appears as though partially encapsuled. The nipple is flat and inconspicuous, but it is not retracted. The skin over the tumour is smooth and not affected. From a multipara, aged 85, who had noticed a painful tumour for six weeks. The breast was removed, but the disease recurred and the patient died six months later with extensive painless recurrences.

Presented by Sir John Bland-Sutton.

2099 A. A section of a breast showing a large multilocular cyst containing an intracystic growth. The breast is bulged outwards beneath the nipple, which is normal. Above the level of the nipple normal breast tissue is to be seen. Most of the cysts in the recent state were filled with a thick yellowish fluid, while in a few the fluid was blood-stained. The intracystic growth is not confined to one loculus, it appears to be invading many loculi.

Microscopically the growth shows finely branching papillary processes composed of a scanty fibrous stroma supporting large numbers of short columnar and cuboidal cells which show considerable irregularity in their arrangements and in many places are not strictly limited by a basement membrane. In places are to be seen spaces filled with structureless material. The growth is a duct carcinoma of low malignancy.

2114. A breast removed *en masse* for cancer with "Fell's paste." There are nine parallel incisions extending through the gland. The posterior surface is smooth.

Cysts and Ducts in relation to Cancer and Papillomata of the Breast.

Demonstration by Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S.

Cancer, more commonly than was generally supposed, began in ducts and in cysts that were of duct origin. How convoluted ducts had come to be called cysts, was seen from nine lantern slides now shown, in which "cysts" were demonstrated to be part of convoluted tubes from cutting sections in series. "Cysts" used in this connexion appeared to be a misnomer, but for the present it would be more convenient to adhere to the usual clinical nomenclature. At the same time it should be borne in mind that acini also formed cysts, which being terminal and not parts of tubes had greater claim to the term "cyst." Both kinds were common in the same breast. Both kinds contained papillomata. An acinous cyst did not contain papillomata with coarse fibrous tissue stalks, whereas duct papillomata did. An acinous papilloma was lined with beautiful elongated feathery cells. Duct papillomata were lined with columnar cells.

In some ducts sometimes the same type of cell was less commonly seen; it could be determined to be a duct only on examination of sections in series, or upon its containing also columnar cells. An acinus never contained columnar cells, typical of a duct

Sir Lenthal Cheatle then proceeded to demonstrate from whole sections cut in series that:—

(1) Simple duct papillomata might be very few in number when present in a breast.

(2) That duct cancer might likewise appear as one or more primary tumour or tumours respectively.

(3) That simple papillomata might be present in so multiple a number that they grew from practically the entire epithelial surfaces of one or more ducts.

(4) That cancer, like multiple simple papillomata, might affect genetically extensive surfaces of epithelium in one or more ducts of a breast, in which case the papillomatous formation, though present, was not so marked a feature as when the duct cancer was a single tumour.

(5) Therefore, cancer might begin as primary foci in different parts of the same breast.

(6) That there was reason to believe this genetic process was progressive and

(7) That columnar epithelium could change its shape and become spheroidal or cuboidal in simple duct papilloma, in the tumour of a primary duct cancer, and that this change in shape invariably occurred when the cells of a duct cancer reached the lymphatic system, where they lost the papillomatous formation as well.

A section of duct cystic breast was shown that contained one benign papilloma. Another breast was shown that contained one large duct cancer, the epithelium in which was purely columnar in type. A large area of "infiltration" (Handley) of the lymphatic system was pointed out. In this the epithelial elements had assumed "spheroidal" and "cuboidal" shape, and all papillomatous formation had been lost. Had only this large lymphatic spread been cut a diagnosis of "spheroidal" or "cuboidal" celled carcinoma would have been made, or a diagnosis even of "scirrhus" or "alveolar cancer." All these terms meant practically nothing so far as the source of origin was concerned. In order to be sure of gaining the full extent of knowledge attainable from microscopic examination, the importance of whole sections was emphasized. Another breast was shown containing a large duct cancer in parts only of which were to be seen the unquestionable columnar cells. The rest of the tumour contained spheroidal or "cuboidal" cells, showing that even in a duct cancer tumour itself the columnar cells might change in shape. Sir Lenthal was not inclined to accept off-hand the theory that this change in shape was due entirely to mutual pressure. It might be due to cells, in growing, assuming characters of a lower type of epithelium.

The lecturer next demonstrated what he called "a striking pathological picture" of a breast sent to him for examination by Mr. Sampson Handley. In it were contained two ducts which were distributed on opposite sides of the breast. Both ducts were so full of papillomata that seventy could be counted in one section. Most of the tumours were of about the same size but two situated one on each ampulla were much larger. Most of the papillomata were benign in character and maintained a pure papillomatous formation, though they were more branched and less pedunculated than that shown in the first breast exhibited. In at least three parts of this breast, one at each opposite side of the periphery and the third at the periphery in the middle line, were tumours which had lost the pure papillomatous formation, and cells were filling the ducts with greatly disordered growth. These ducts led direct to infiltrating cancer in the three isolated parts above named. No connexion could be traced between them in the serial section. The determining factor of their presence was the disease in their respective ducts. Some of the papillomata that looked benign were lined with cells "spheroidal" and "cuboidal" in shape. The shape did not depend upon the angle at which they were cut nor did it appear that pressure could have made more impression on it there more than elsewhere, where the cells were typically columnar. This breast contained benign papillomata, papillomata of doubtful benignity and those definitely cancerous in nature.

The lecturer pointed out how tempting the proposition would be to explain the localization of incidence of the disease in this breast; by asserting that it had been caused by the entrance of some living or lifeless irritant through the duct orifices of the nipple. That temptation would be greater as this demonstration proceeded. This breast also showed that cancer might begin in primary foci in different parts of the same breast.

Then were shown in sequence whole sections of four cancer-containing breasts: all contained "infiltration" of the lymphatic system and all contained cysts with cancer in them. These cysts were proved by serial sections to be ducts, a fact which altered the present conception of the whole position of cancer of the breast. The cancer in the ducts was not due to the presence of an ongrowing cancer beginning elsewhere, but occurred as a primary cancer process, extending over large tracts, in the cells lining the affected ducts. The first of these four breasts contained a duct in which the primary cancer process was operating throughout the whole of its course from the nipple to the extreme periphery. This duct and its branches were traced through whole sections of the breast in serial sections. Finally it was assembled in a schematized duct, one main branch of which passed vertically down the middle of the breast and received a tributary. Another passed downwards towards the outer and lower part and received two tributaries, and finally the main duct divided into three at its termination. All were full of cancer and in them the living cells could be seen undergoing metaplasia into malignant disease. It was pointed out that it was possible to show only a part of the duct distribution in the plane from which it was schematized, and that it would be impossible to imagine that only those branches which contained cancer were the only branches thus accidentally schematized. Therefore there must be many more not connected up with this scheme, and the cancerous part of this breast looked like it. The right half of the breast was comparatively normal. It was in the left half that cancer was so abundant. And apparently more than one duct was diseased because the top of another duct appeared in the series, that also contained the same primary cancer process.

The next breast showed the same changes in a less extensive degree. It was remarkable for this reason in that it showed " infiltration " at the periphery of the duct distribution. The lecturer ventured to explain this fact by showing that here the ducts were not surrounded by thickened sclerosed fibrous tissue coats and therefore " infiltration " could more easily occur. Terminations of normal ducts were shown to demonstrate how slight was their fibrous tissue element.

In the third breast, a tumour near the nipple was shown. This tumour had drawn the patient's attention to her breast. Whole sections were cut. The tumour near the nipple contained only the infiltration of a lymphatic spread. On tracing a duct to the interior of the breast one of its branches, which had been cut transversely, contained cancer ; but no other disease could be found in the section. Fortunately the rest of the breast had been kept. One part of it appeared on manipulation to be a little more dense than the rest. This part was examined and found to contain extensive cancer of the duct, cystic type, with infiltration about it. This was taken as a proof that extensive cancer might exist in a breast and "clinically" give no indication of its presence—a very serious state of affairs.

The last breast demonstrated was shown to indicate that the primary cancer process when once established in a breast was by no means limited to the part affected, but was progressive in ducts of other parts. The ducts of other parts contained early forming cancer changes and metaplasia into malignant growth was occurring.

Finally the orifice of a normal duct was shown as the duct passed through the nipple to open on the surface. It could be seen opening into the centre of a little pit and seemed to be inviting the entrance of a living or lifeless irritant were it presented at that part.

DISCUSSION.

The PRESIDENT said that it had recently been stated that more than one hundred names were being or had been applied in a very ill-defined fashion to the so-called benign swellings of the breast. Sir Lenthal Cheatle had instituted a great advance by his large sections in series through the whole breast. It had been a most laborious work, but was well worthy of imitation in pathological laboratories of all hospitals. In an order the reverse of the demonstration just given, the President noted that Sir Lenthal Cheatle had described an affection commencing in one or two of the ducts at the nipple, and spreading by the secondary ducts into the depth; the ducts became dilated and convoluted into what had been previously called cysts. This dilatation and convolution Sir Lenthal had traced to a proliferation of the columnar epithelium proceeding from the main duct into its branches; in places he recognized a change in the columnar cells into those of a more spheroidal form, which might be taken to be malignant. At this stage, even whilst the basement membrane limiting the ducts remained intact, groups of cells might be found in the lymphatic channels outside the actual gland substance. This point and the evidence that the disease began near the nipple, suggestive of an external cause entering by the nipple, were both of first importance.

Mr. SAMPSON HANDLEY said that Sir Lenthal Cheatle had demonstrated the value of the giant microtome method in elucidating the pathology of breast carcinoma, and had established beyond a doubt the fact that most carcinomata of the breast originated in the ducts: this was probably the most important contribution of recent years in regard to the ætiology of breast cancer. It was also very interesting to know that a papillomatous condition of the ducts might be found throughout the whole of the duct system of one or more lobes of the breast. Without the aid of the giant microtome this could hardly have been demonstrated. He welcomed the paper from another aspect as betokening a revival of interest in the much-neglected science of pathological anatomy. Although a distinguished morbid anatomist—the late Sir James Goodhart—had pronounced a funeral oration upon the science, "The Passing of Morbid Anatomy," there could be no doubt that the study of morbid anatomy on modern and systematic lines would still yield valuable results, as indeed Sir Lenthal Cheatle's paper showed.

Mr. McADAM ECCLES said that he would ask Sir Lenthal Cheatle four questions bearing upon his most suggestive demonstration :—

(1) If, as he apparently proved by his beautiful serial sections, they were in future to consider mammary "cysts" as "convoluted ducts," what was the cause of the convolution, and had it a bearing upon the incidence of carcinoma?

(2) Did he believe, from the sections he had shown, that carcinoma might commence at the periphery (beneath the nipple) and progress towards the centre? Sir Lenthal showed a columnar-celled growth present beneath the nipple with a cubical and even spheroidal-celled carcinoma towards the deeper parts of the mamma ; were these cells continuous and were they stages one of the other?

(3) Had the so-called "chronic mastitis" a relationship with the proliferation of cells in the ducts, a proliferation which in certain cases would seem to foreshadow carcinoma?

(4) Did the incidence of mammary carcinoma, on the lines Sir Lenthal had indicated, favour the parasitic theory of its origin, and of infection from the periphery to the centre, that was, from the open mouth of the duct at the nipple to the deeper and branching part near the acini?

Sir G. LENTHAL CHEATLE (in reply to Mr. McAdam Eccles' questions) said that—

(1) The causes of convolution in ducts were probably many. A breast varied in size during healthy functions. In accommodating themselves to the small size of a breast in inactivity, after it had been active, ducts must become convoluted to maintain their position in the new confines of the breast. The bearing convolution or the formation of these pseudo-cysts had on the incidence of cancer might be this. The dilatation of the ducts and their elongation might be partly due to an attempt to provide accommodation for the contained proliferating epithelium of a simple or malignant nature. If subsequently it could be demonstrated that a living or a lifeless agent did enter the ducts at the nipple and influenced incidence growth in some manner, then convolutions would act as vehicles in which a stagnant irritant could act without disturbance. Mr. Eccles would see, if he referred to the *British Journal of Surgery*, October, 1920, that he there stated definitely that all cysts were not duct in origin, some were acinous, but it was in the duct-cysts that cancer commonly arose.

(2) At present he did not wish to (*a*) make a definite statement. The sections he had shown on the whole seemed to him to indicate that the dangerous "cysts" were almost microscopical, and therefore cancer arising in them would appear towards the periphery of a duct, which did not necessarily imply that it would occur at the periphery of a breast.

(*b*) There were two columnar-celled growths below the nipple in Mr. Sampson Handley's specimen, each occupying a different duct. In tracing these ducts through serial sections normal epithelium could be seen between the multiple papillomata that existed in them. The appearance suggested to him that some of these papillomata were really malignant, and more distinctly so at the periphery of the ducts in question. And that infiltration into the lymphatic system occurred sooner when the duct had become so small that its insignificant coats rendered infiltration more easy.

He did not pretend to be able to solve the question whether a simple papilloma was a stage below a malignant papilloma. He would again refer Mr. Eccles to his paper in the *British Journal of Surgery*. All he could be prepared to say now was that he would prefer to see a breast containing multiple simple duct papilloma in one or more ducts in the pathological laboratory rather than in its normal position.

(3) He was sure that "chronic mastitis" was a very elastic term, which was applied to many conditions of the breast that had no claim to it. For instance, most of those breasts, from which he had shown that cysts were really ducts, and that striking breast which Mr. Sampson Handley had sent him for examination, contained little or no sign anywhere of active chronic inflammation. Nor would it be wise to assume they were in a post-chronic inflammatory state. Mr. McAdam Eccles' question was such an important one that he would welcome an opportunity of fully discussing it. To do so now would take up more time than was at their disposal.

(4) He did not consider that the incidence of cancer, on the lines he had indicated, favoured a parasitic theory more than the theory of a lifeless irritant. And many factors might be of the utmost importance, of which age seemed to be one.

Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.

President—Mr. E. Laming Evans, C.B.E., F.R.C.S.

Late Case of Birth Palsy.[1]

By P. Maynard Heath, M.S.

W. P., male, aged 12. Born as a breech presentation. First came under observation in 1913, at age of 5. The right arm was then quite useless, but was strongly rotated inwards, and held to the side. The forearm was pronated.

After ineffectual attempts to overcome the internal rotation by means of apparatus, an open operation was performed and the capsule of the shoulder-joint and the subscapularis muscle were divided. External rotation was at once obtained. There is no record of the electrical reactions of the limb muscles at this period.

The boy was lost sight of during the war, but has been seen again recently. All the limb muscles have recovered, and they react briskly to faradic stimulation. The limb is very small compared with that on the sound side, and the shoulder-girdle is considerably elevated. The arm can be abducted and rotated outwards. Movements at elbow are poor, and supination of forearm is completely lost owing to forward dislocation of head of radius. The wrist is held extended, and the boy is unable to extend his three inner fingers. If the wrist be passively flexed the fingers can be extended.

DISCUSSION.

Mr. Heath asked for opinions as to whether excision of the head of the radius would improve movements at the elbow-joint.

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[1] At a meeting of the Sub-section, held December 7, 1920.

Mr. Fairbank called attention to the remarkable tendency to contractures of muscles about the shoulder-joint in these cases, and the necessity for daily manipulations to prevent these. He had seen several cases of radial dislocation associated with birth palsy, but had not removed the head of the radius in such a case. He considered it improbable that the operation would cure the limitation of supination.

The President agreed that removal of the head of the radius would probably not cure the limitation of supination.

Case of Deformity about the Shoulder-joint.

By P. Maynard Heath, M.S.

H. C., female, aged 16, has always complained of pain and difficulty in raising the right arm. She can abduct the arm to the horizontal fairly easily, but then some obstruction seems to arise. On making further efforts a sudden movement occurs in the shoulder-joint, as if a subluxation were produced; the arm is carried a little forward, and can then be elevated to the vertical.

On examination the right scapula is found to be a little higher than the left; the trapezius muscle is very poorly developed, and the rhomboideus major muscle stands out as a thick band. No abnormality can be detected in the shoulder-joint. There is slight asymmetry of the face, the right side being the smaller, and there is slight shortening of the right sternomastoid muscle. There is a scar in the neck where a tuberculous gland was removed. The operation was subsequent to the onset of the shoulder trouble.

X-ray plates of the shoulder-joint in various positions show no abnormality.

I think that the condition is probably a congenital defect, as evidenced by the elevation of the scapula and the want of development of the face.

DISCUSSION.

Mr. Elmslie thought the condition due to weakness of the shoulder muscles, chiefly the trapezius, and possibly the result of poliomyelitis. He did not consider it a case of Sprengel's deformity, which was usually associated with abnormalities in the ribs and spine.

Mr. Fairbank agreed that it was not a case of Sprengel's deformity. He had never seen a case of true congenital elevation of the scapula without very definite partial fixation of the bone. In this case the scapula moved freely over the chest wall. He thought the case due to deficiency of the trapezius, and probably of congenital origin.

Mr. HEATH (in reply) failed to see why the case should not be regarded as a very mild type of Sprengel's shoulder.

Fracture of Right Semilunar Bone.

By PAUL BERNARD ROTH, F.R.C.S.

A. C., AGED 22, a deal porter, was referred to me on November 4, 1920, by Mr. Kenneth Walker, suffering from inability to dorsiflex the right wrist beyond the mid-position. He stated that twelve months previously he had fallen off a pile of wood 30 ft. high, and hurt his right wrist badly, not being able to work for two to three months. The wrist was very painful at first and very swollen. His doctor sent him to a hospital, where he had massage every other day for two months or more. No splint was applied. He returned to work, but did not use his wrist for another three months. He is now able to do his work, but is apt to knock his fingers, causing a burning and tingling up the forearm.

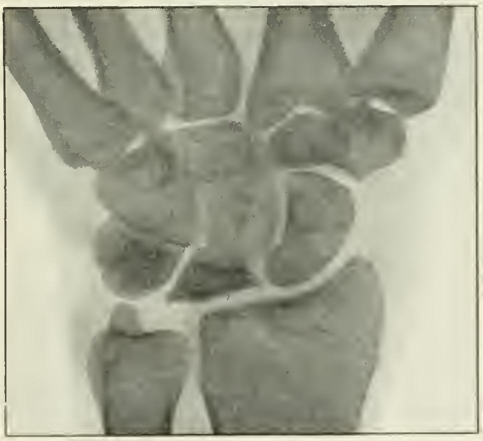

FIG. 1.

Radiogram of right carpus showing impacted fracture of semilunar bone.

On examination, his chief disability was the limitation of dorsiflexion.

Radiographs taken by Dr. Salmond showed very marked atrophy of the right semilunar bone without displacement.

I conclude this is a case of impacted fracture of the bone, with subsequent healing and loss of bulk.

Treatment has consisted in placing the wrist in a "dorsiflexed wrist splint": after three weeks he can now dorsiflex the injured wrist as well as the uninjured.

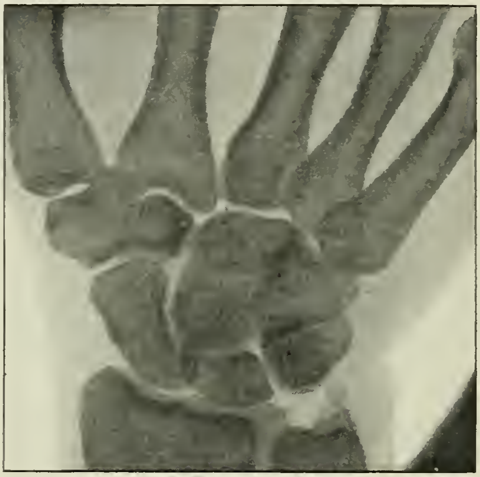

Fig. 2.

Radiogram of left carpus for comparison.

The PRESIDENT thought the case unusual in that there was no displacement of the semilunar bone, and little or no arthritis.

Charcot's Disease of the Spine.

By R. C. ELMSLIE, M.S.

A. S., A MAN, aged 39, came to St. Bartholomew's Hospital on October 20, 1920, complaining of a deformity of the spine, noticed for two to three months. In 1917 he first suffered from pain over the lower ribs. He attended a hospital in Edinburgh at that time, and says that he was told that he had "general neuritis," the legs being most affected.

The spine shows a severe kyphosis in the lower dorsal and lumbar regions; there is no angular curve and there is comparatively good mobility. The man gives his normal height as 5 ft. 4½ in.; his present height is 5 ft. 1½ in. An X-ray photograph was taken, and a very curious condition found. There are very extensive changes involving the lower dorsal and all the lumbar vertebræ, the fourth lumbar being most affected. The condition is characterized by bone destruction and bone proliferation, the latter being most evident along the anterior and lateral margin of the vertebral bodies. It is as if the bodies of the vertebræ had worn away and new bone been formed around their margins.

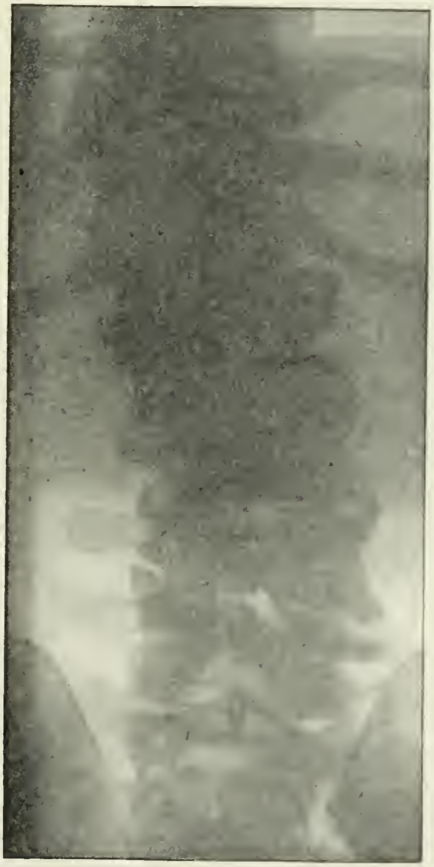

FIG. 1.

FIG. 1.—Case of Charcot's disease of the spine. Autero-posterior view.

The radiographer, Mr. Martin Berry, reported that the appearances suggested Charcot's disease of the spine. The examination showed that the man has unequal pupils which do not react to light, but do to a slight extent to accommodation. Knee-jerks are absent. A Wassermann reaction in the blood is negative; the cerebrospinal fluid has not been examined. I think that there is no doubt that the man has tabes and Charcot's disease of the spine.

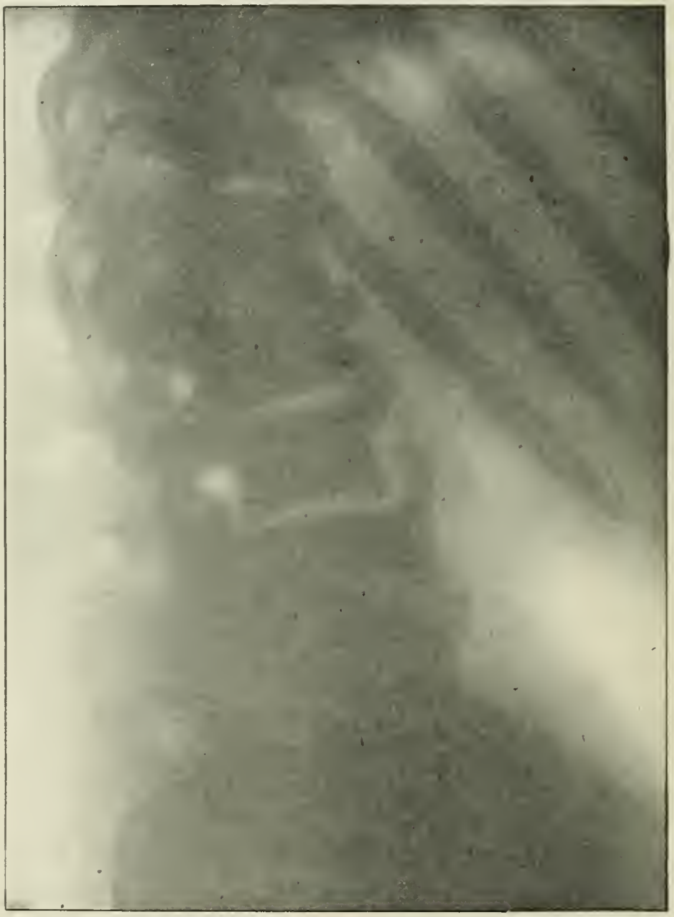

Fig. 2.

Fig. 2.—Case of Charcot's disease of the spine. Lateral view.

DISCUSSION.

The PRESIDENT: Has anyone present ever seen a case?

Mr. BANKART said he had seen one case, and mentioned that others had been collected by Targett.[1]

Case of Fibrous Union of Femur.

By A. W. SHEEN, C.B.E., F.R.C.S.

F. J. E., MALE, aged 30. History given by patient: Blown up in trenches on July 21, 1916, and sustained simple fracture of right femur; treated by splint and weights; no union. October 9, 1916: Fracture plated with two plates. January, 1917: Plates removed; operation wounds healed at once; Thomas's splint and crutches for some time; left hospital in June, 1917, and began to walk without any appliance. Started at his pre-war work of French polishing in January, 1918, and has continued it ever since. Limb has been in its present condition for three years. He says he can walk a mile or more without fatigue and that he is not anxious for any further treatment.

On examination there is seen to be strong fibrous union of the fracture, a little below the middle of the right femur; mobility is marked on lateral but not on antero-posterior movement; the ends are bowed inwards carrying with them the artery; 3 in. shortening, for which he wears a high boot; malleolar separation, 6½ in.

X-ray, taken by Mr. Russell Reynolds, shows much callus, the inward bowing and, in the lateral view, overlapping, with the upper behind the lower fragment.

DISCUSSION.

The PRESIDENT referred to a case of ununited fracture of the femur in which the weight was transmitted through a plate and screws. He advised a leather support for this case and not operation.

Mr. ELMSLIE thought operation advisable and should be urged, and that only if operation was refused should an appliance be ordered. Whether he wore it or not must be left to the patient himself.

Mr. ROTH urged operation because of the present strain on the joints of the limb. Trouble in the joints was bound to occur sooner or later if the femur were left alone, and the man was only 30 years of age.

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[1] *Guy's Hosp. Gaz.*, 1895, n.s. ix, p. 133.

Case of Flail Shoulder.

By A. W. Sheen, C.B.E., F.R.C.S.

E. W. W. H., aged 37, wounded in the right shoulder in France on May 22, 1916. History given by patient: On the day of wound the head of the humerus was removed; the wound was healed by September, and on September 23 a bone graft, 4½ in. long, was put in from his leg, there being 6 in. of humerus missing. In February, 1917, the upper 2 in. of the graft was removed because it had "gone dead." In February, 1919, he was fitted with the appliance he now has; this he has hardly worn at all because it is too heavy and stiff and makes his fingers numb.

On examination the arm hangs loosely from the side and cannot be actively moved therefrom. The head and adjacent part of the humerus are missing. The graft can be felt curving inwards at the top. Scarring and tissue loss have produced a deep constriction, only 8½ in. in circumference round the top of the humerus. The deltoid is quite divided and useless and shows no faradic response; the pectoralis major contracts and moves the shoulder slightly. The elbow cannot be bent nor extended, but the biceps and triceps react easily to faradism and the short head of the biceps is intact. Otherwise the arm below the injury is normal and well nourished and there is no muscular, vascular, or nervous disturbance.

The appliance enables him to bend the elbow (which can then be fixed by studs) when he brings forward the opposite shoulder. The man is at work at watch and clock repairing.

The X-ray, by Mr. Russell Reynolds, shows the graft thinned at top and reaching the lower margin of the glenoid; also a piece of metal in the axilla.

DISCUSSION.

Mr. Elmslie thought arthrodesis of the shoulder should be advised but not urged. He had used the fibula to replace the upper end of the humerus in three cases. In two with the deltoid acting, the results were good. In this case he advised removal of bad bone at tip of graft, bending down the acromion, and the insertion of a 5 in. bone peg down through the base of the acromion into the shaft of the humerus. An appliance would probably be of no use. The weakness of the elbow he regarded as functional, but improvement in this respect would have a better chance if the shoulder were fixed.

Mr. MARSHALL called attention to the effect of stretching of the muscles about the shoulder in this and similar cases and thought this interfered with the function of the elbow. He agreed that an attempt at arthrodesis ought to be made.

The PRESIDENT agreed with Mr. Marshall as to stretching of muscles interfering with recovery of function in shoulder cases, but thought the absence of a fulcrum was important in a case like this.

Suture of the Ulnar Nerve in a Girl, aged 10.

By B. WHITCHURCH HOWELL, F.R.C.S.

G. W., FEMALE, aged 10, received a severe cut on the right wrist and forearm on December 24, 1919. This was stitched up in the casualty department at the Queen's Hospital for Children, Hackney Road.

I saw her in April, 1920, for a paralysis of all the muscles supplied by the ulnar nerve below the level of the wrist. The nerve was explored on April 24, 1920, found divided (a band of fibrous tissue connecting the neuromata) and end-to-end suture performed with very fine catgut.

On August 26, 1920, there seemed to be some suggestion of voluntary response in the intrinsic muscles; there was a good galvanic, but no faradic response. On October 31, 1920, there was a good faradic response of all the ulnar group. On November 20, 1920, there was still some ulnar adduction of the little finger. Sensation and localization good over the palmar aspect of the ulnar nerve supply; poor, if any, over dorsal aspect. Tinel's sign to finger-tips. Hypothenar muscles strong; interossei getting firmer.

The PRESIDENT regarded the case as a very good example of recovery after injury of the ulnar nerve close to the wrist. Recovery when the lesion was higher up was rarely seen in the intrinsic muscles of the hand.

Case of Bilateral Snapping Hip with Functional Varus.

By H. A. T. FAIRBANK, M.S.

I. D., AGED 11. In May, 1920, some creaking was noticed in the right hip when rubbed. Since then the "snapping" of the right hip gradually developed and now both hips "snap." She can produce the snap both when standing and when lying flat. In order to produce the snap she puts the hip in a position of adduction with a very little flexion; the snap is produced by a movement of flexion plus external rotation, and again on rotating the thigh in. When lying flat she gets the necessary adduction by tilting the pelvis up on the side on which the snap is to be produced. The snapping on the left is not so violent and loud as that on the right. Palpation during snapping suggests that the phenomenon is produced by the deep tendon of the gluteus maximus slipping forwards and backwards over the great trochanter, not by the ilio-tibial band nor in the hip-joint itself. It is expected that operation will reveal the presence of a specially well developed tendon on the deep aspect of the gluteus maximus, as described by Wood Jones as being present in these cases.

Extension of the hip-joint is somewhat limited on both sides, and abduction is not quite free on the right.

Radiograms of the hip-joint are negative.

For the last five or six weeks the right foot has turned in. The degree of varus is variable, and she can be induced to correct it voluntarily for a few moments. Dr. Kinnier Wilson kindly saw the case and confirmed the diagnosis of "functional varus."

It is proposed to operate on both hips, and if the condition described by Wood Jones is found, to attach the gluteal tendon to the back of the trochanter.

DISCUSSION.

The PRESIDENT had operated on three or four cases and found no special tendon. In his cases the ilio-tibial band was the cause of the snap. He had not seen a case with a to-and-fro snap as in this case. He suggested rest in plaster should be tried. He had treated a case successfully by this method.

Mr. ELMSLIE had seen the operations on which Wood Jones founded his paper, and he saw the tendons described. The snap could only be produced at the operation, while the gluteus maximus was being stimulated electrically.

Mr. FAIRBANK (in reply) said he would certainly try the treatment suggested by the President.

Case of Subluxation of Right Hip-joint, following Trauma.

By T. TWISTINGTON HIGGINS, O.B.E., F.R.C.S.

BOY, aged 8. The history was that in August, 1919, he fell from a tree and injured his right hip. Three weeks later he was taken to hospital (Portsmouth) where an X-ray photograph showed a "dislocation of the head of the femur into the thyroid foramen." The dislocation was reduced under an anæsthetic and the leg put up in plaster. Eventually he returned to school and a few months later a limp developed, which became progressively worse. He was brought up to London on this account. It was then found that the right hip was practically fixed in a position of flexion and slight adduction. There was ½ in. to ¾ in. real shortening and prominence and slight elevation of the great trochanter. Radiogram (fig. 1, November, 1920, p. 64), showed the head of the femur subluxated apparently upwards and backwards, together with some rarefaction and alteration of structure of the femoral neck; the epiphysis appeared well formed.

The case is considered to be one of partial subluxation, with possibly commencing fibrous ankylosis—the result of the original trauma—and the treatment suggested is to attempt reduction under an anæsthetic, and, if possible, fixation of the hip in the abducted position in plaster.

The case is thought to be interesting on account of: (1) The history, apparently definite, of traumatic dislocation; (2) the present condition of the hip and the possibilities of treatment.

DISCUSSION.

Mr. FAIRBANK thought the trauma had set up a mild simple arthritis, and that the capsule had become softened and this allowed subluxation of the adducted hip to occur. He agreed to the treatment suggested. He referred to three cases of subluxation resulting from tubercular disease without destruction of bone, but he did not consider this case to be tubercular.

Mr. ELMSLIE suggested that Mr. Higgins should try to get a copy of the original radiogram, in view of the extreme rarity of traumatic dislocation in children. He had reported a case of traumatic dislocation of the hip in a boy, aged 4: his case developed the changes characteristic of pseudo-coxalgie later. He had only been able to find one other case in the literature. In this case he suggested simple ankylosis was taking place.

Note.—A copy of the radiogram (fig. 2, August, 1919, p. 65), taken at the time of the original injury has been obtained since the case was shown to the Sub-section. This shows a definite and complete dislocation downwards and inwards of the right hip.

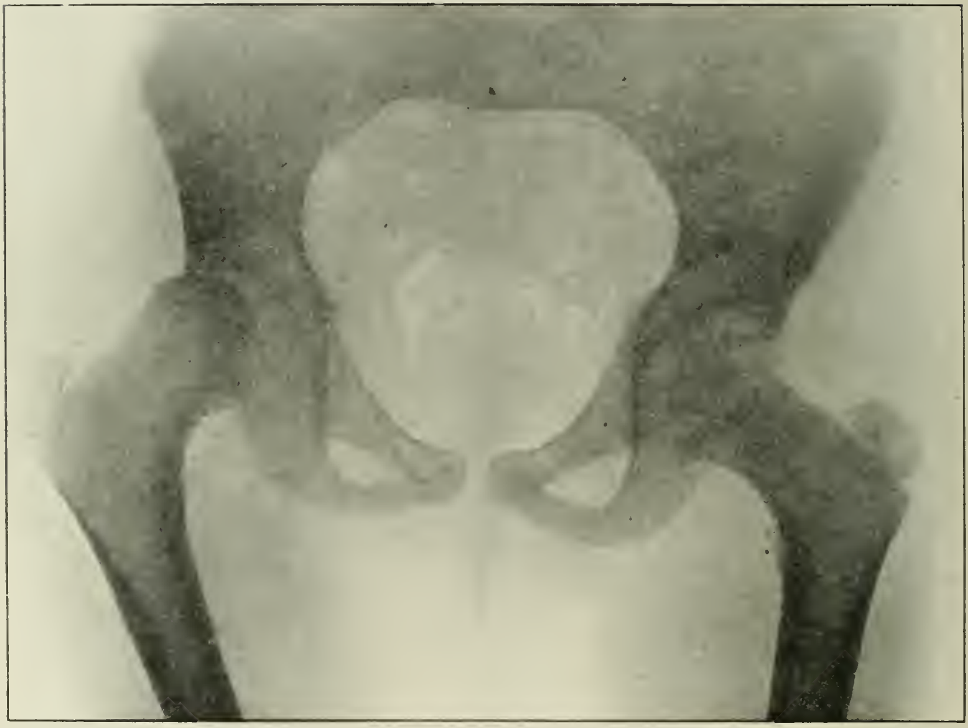

Fig. 1.

Radiogram showing subluxation of right hip.
(November, 1920.)

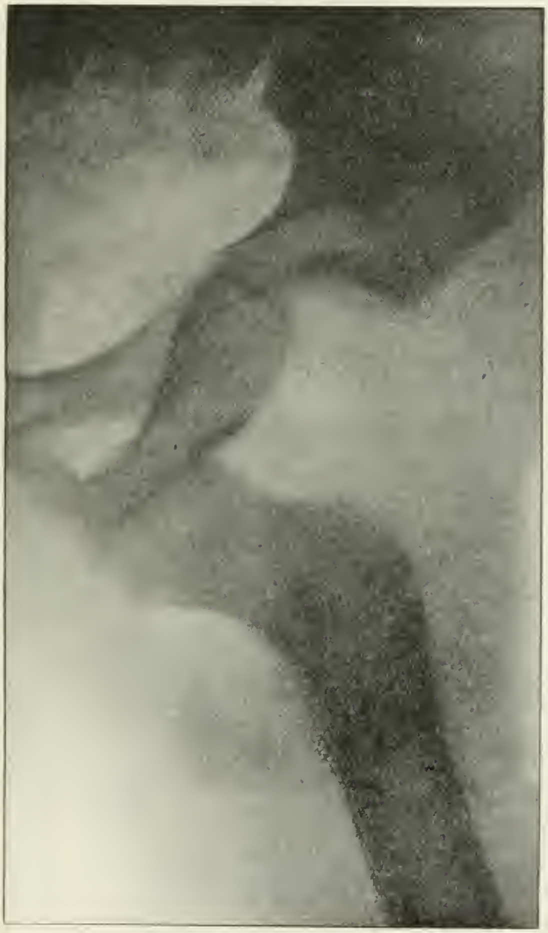

FIG. 2.

Radiogram taken soon after original injury showing traumatic dislocation. (August, 1919—Portsmouth.)

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. W. Ernest Miles, F.R.C.S.

PRESIDENT'S ADDRESS:

How soon should Colostomy be performed in Cases of Cancer of the Rectum which are Inoperable?[1]

By W. Ernest Miles, F.R.C.S.

There is no doubt that the work of this Sub-section has largely increased the interest taken in the study of proctology, and already there are signs that our medical schools have begun to realize that the subject is worthy of being taught to students as part of their curriculum. The Middlesex Hospital, by forming a Department of Proctology, has taken a step in the right direction, and I hope the other schools will soon follow their example. When this comes about, men will no longer go out into the practice of their profession with next to no knowledge of rectal complaints, and the day will have passed when an early carcinoma of the rectum will remain undetected for want of a timely rectal examination. Let us hope that in the near future we shall no longer see so large a proportion of cases of rectal cancer that have passed beyond the stage of operability. This brings me to the subject on which I propose to offer a few remarks to-day.

By an inoperable case I mean not only one in which the condition is so advanced that complete removal of the growth is impossible, but also one in which, even though the growth be comparatively restricted, the age of the patient or his unfavourable general state renders a radical operation out of the question. Under such circumstances the question arises of performing colostomy in order to prevent the occurrence of intestinal obstruction, which is the usual termination of many of these cases. We shall then be called upon to decide whether colostomy should be performed at once or whether it should be delayed until there are definite signs of impending obstruction. The matter is not easily disposed of, for not uncommonly the patients themselves, and too often the medical advisers as well, regard colostomy as a calamity to be deferred as long as possible. The idea usually advanced is that there will be time enough to resort to it when life is in danger from an impending attack of absolute obstruction. Such a contention would be reasonable if absolute obstruction only supervened at a definitely known period during the course of the disease, and if the premonitory symptoms were always gradual in development. Unfortunately, however, in some cases the attack occurs rapidly and without warning, though in others its advent may be long delayed. Moreover, in the interim, be it short or long, many complications may arise during the progress of the disease which materially increase the suffering of the patient and which a timely colostomy would greatly relieve or entirely obviate.

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[1] At a meeting of the Sub-section, held November 10, 1920.

Since the site of the growth in the rectum has considerable influence both on the time of onset of absolute obstruction and upon the nature of the other complications, I propose to consider whether colostomy should be performed early or late in cases of cancer situated (*a*) at the recto-sigmoidal junction, (*b*) in the ampulla, and (*c*) in the anal canal.

(*a*) *Growths situated at the Recto-sigmoidal Junction.*

When carcinoma occurs at the recto-sigmoidal junction it conforms to the type generally met with in the colon, in that it spreads rapidly round the whole of the circumference of the bowel and produces stenosis. In these cases the earliest symptom to attract attention is increasing difficulty in the movement of the bowels. Alternating attacks of constipation and diarrhœa, which herald the early onset of absolute obstruction, soon make their appearance. When such a case, for some reason or other, is found to be inoperable, should colostomy be done at once, or should it be deferred until it becomes absolutely necessary to avert death from complete obstruction? The answer is to be found in the records of our experience of the complications that may arise during the progress of these cases before the onset of obstruction. In the first place, diarrhœa may be so persistent as to necessitate relief of the bowels many times during the day and night. The patient suffers great distress and rapidly loses ground from having his rest disturbed.

Quite recently I saw a patient with a growth in the lower part of the pelvic colon which caused the most persistent diarrhœa. During the previous twenty-four hours he had had twenty-three actions of the bowels. As an operation for removal of the growth was entirely out of the question, I advised immediate colostomy. He refused to submit to it and died a month afterwards. I subsequently learned that on seeking further advice, he was told that colostomy was unnecessary as obstruction did not exist. I have no doubt whatever that had colostomy been performed when I suggested, the diarrhœa would have ceased, the patient would have lived longer than he did, and the remaining days of his life would have been free from much of the misery. Again, a growth of this type, besides causing stenosis, may penetrate the wall of the bowel and produce a weak spot which gives way under the strain of violent peristalsis. Some years ago I met with such a case.

The patient not having had an action of the bowels for some days, took a large dose of castor oil before retiring to bed. During the night he was seized with violent pain in the abdomen, became collapsed, and died twelve hours afterwards. At the autopsy a carcinomatous growth was found at the recto-sigmoidal junction, with rupture of the coats of the bowel just above the growth, from which a large quantity of fæces had escaped into the peritoneal cavity.

In another instance I was called in consultation upon a patient suffering from a large acute abscess in the suprapubic region from which, on being opened, fæcal material escaped freely. On further examination it was found that the patient had a carcinoma of the upper part of the rectum. The growth having penetrated the whole thickness of the wall of the bowel, had allowed leakage to take place, resulting in a large suprapubic abscess. Colostomy was performed, but the fistulous opening in the pelvic region remained and caused the patient much distress from the constant discharge of pus mixed with blood and mucus.

In both these cases there is no doubt that colostomy, if it could have been done early, would have frustrated these occurrences.

Lastly, an attack of absolute obstruction may be precipitated suddenly and without previous warning, either from the stenosed segment of bowel becoming intussuscepted into the lumen of the bowel below, or from a large mass of fæces having become impacted above the growth. In either case, colostomy must be performed under the most disadvantageous circumstances and, in some instances, may not be possible at all owing to the distension of the colon with solid fæces.

During the progress of carcinoma at the recto-sigmoidal junction it is not possible to predict when the complications, to which I have alluded, may arise; and therefore much the safer plan is to perform colostomy as a preventive measure at the earliest possible moment.

(*b*) *Growths situated in the Ampulla of the Rectum.*

Owing to the large diameter of the bowel in this situation an attack of absolute obstruction does not take place until the disease has reached a very advanced stage, and, indeed, in a considerable number of cases it does not occur at all. Hence, if colostomy is postponed until the signs of obstruction are impending, the patient will have endured much misery from various complications which earlier intervention would have spared him.

It is not only in advanced cases, however, that the expediency of early colostomy has to be considered. It may happen that, owing to an unfavourable general condition of a patient, a carcinoma in quite an early phase of development cannot be removed. A case of this kind came to my notice a few years ago.

An old gentleman, aged 74, the subject of chronic bronchitis and emphysema, was suffering from an early carcinoma of the ampulla. The surgeon with whom I was asked to consult and myself both agreed that an operation for removal was inadvisable and the question arose as to treatment by radium. I agreed that it should be tried but maintained that, before doing so, colostomy should be established. The patient strongly objected to colostomy. Radium was applied. After the third application, an acute attack of absolute obstruction supervened. Colostomy was then done, but the patient died within twenty-four hours after the operation. The passage of fæces over the surface acted upon by the radium set up acute inflammatory reaction with œdema of the submucosa in sufficient degree to obliterate the lumen of the bowel.

The lesson to be learned from this case is that methods of treatment such as radium and diathermy, which of recent years have found considerable favour in the treatment of inoperable carcinoma, should not be employed in the rectum until the flow of fæces over the surface to be acted upon has been diverted by means of a preliminary colostomy.

Let us now consider the case of a growth in a more advanced phase of development, and let us suppose, for example, that the growth has involved one half of the circumference of the bowel. At this period the process is not sufficiently extensive to cause much narrowing of the lumen of the bowel and the risk of the occurrence of an attack of absolute obstruction is very slight; the bowels act freely every day and there is no evidence of stasis in the colon. Still, by the time a growth has involved half of the circumference of the bowel, surface disintegration is well-marked and a state of active ulceration has been reached. The margins of such an ulcer are extremely sensitive, and the passage of fæces over them causes the patient much suffering. He complains of pain in the rectum itself and over the lower part of the sacrum and is troubled with severe tenesmus at each action of the bowels. The ulcerative process is also accelerated by the frequent passage of fæcal material over it and often becomes covered with sloughing tissue. When these sloughs separate, free and copious hæmorrhage occurs. Such attacks of bleeding, when repeated, soon sap the patient's vitality.

By the time, too, that a growth has encompassed half of the circumference of the bowel, penetration of the whole thickness of its oats has probably occurred, and consequent leakage in the peri-rectal tissues takes place. This leads to the formation of pus in the pelvi-rectal space. Such abscesses usually evacuate themselves into the rectum, but sometimes they invade the ischio-rectal fossæ, not infrequently terminating in fistulæ with numerous external openings in the perineum from which pus continually escapes. These fistulæ require repeated operation, but seldom heal, and often become the seat of fungating growth, which adds immensely to the misery of the patient. The pain and the repeated hæmorrhages during this stage of an ampullary carcinoma are practically abolished, and the formation of abscess and fistula is entirely prevented by early colostomy.

Even during a later stage, when the growth has entirely encircled the bowel, an attack of absolute obstruction may not occur. By this time the carcinoma has extended into the peri-rectal tissues, has invaded neighbouring structures, and has involved the sacral plexus of nerves. The condition of the patient is now truly miserable, and colostomy if now performed holds out little prospect of relief. Moreover, though actual obstruction may not exist, the pelvic colon is probably so distended with fæcal material that it is impossible to withdraw a loop of gut from the abdomen in order to obtain an efficient spur.

(c) *Growths involving the Anal Canal.*

A carcinoma in this situation is from the outset accompanied by severe pain at every action of the bowels. This is due partly to greater sensitiveness of the mucosa of the anal canal and partly to spasm of the sphincter and levatores ani muscles. It is true that this pain can be relieved considerably by the operation of linear proctotomy, but in this case the misery of incontinence is substituted. The growth, too, very rapidly penetrates the coats of the bowel when ischio-rectal suppuration with external fistulæ results. Colostomy in these cases affords complete relief especially if combined with linear proctotomy.

Thus, when a case of carcinoma of the rectum, in whatever position it may occur, is judged to be inoperable, the sooner colostomy is performed the better it is for the patient. He is saved much suffering from the various complications that might arise in the interval between the first discovery of the nature of the disease and the time when an attack of absolute obstruction would, in any case, render the operation imperative. From my personal experience of such cases I am of opinion that, as soon as carcinoma of the rectum is considered to be inoperable, every day lost before performing colostomy is a day to the bad.

It appears to be the general opinion among patients and also among medical men that colostomy is a distressing affliction. They conjure up a picture of continual incontinence that necessitates constant attention, and that keeps the patient bedridden. There are of course colostomies that deserve all this abuse, but I am sure that every one of you will agree that if the colostomy has been efficiently performed the popular impression is an absolute travesty of the facts. It is neither unsightly nor uncleanly, nor does it incapacitate the patient either from mixing in society or from participating in his ordinary work. I do not propose to discuss the various methods of performing colostomy, as every surgeon prefers his own means of gaining the desired end. There are, however, two essentials to be insisted upon if a good result is to be obtained—viz., a small opening in the abdominal parietes and an efficient spur.

The opening in the abdominal wall, whether in the iliac region or through the rectus abdominis, should be no larger than is necessary to admit the index finger. In this way the loop of bowel which is withdrawn from the abdomen completely fills the opening, and a certain amount of muscular control is supplied to the colostomy. In no circumstances should the opening be used for purposes of exploration. If this is thought to be necessary, it is much better to open the abdomen in the middle line.

There are several methods of creating a spur, but there are few that ensure a spur that is both efficient and permanent. Should a spur recede, then the colostomy becomes useless for preventing the fæces from passing into the bowel below it. The colostomy then becomes a lateral opening into the bowel: fæces accumulate above the growth, leading to ultimate perforation and pelvic abscess. The method which I have found uniformly successful is to pass a stout silk ligature so as to include the whole width of the mesentery of the protruded loop, and to anchor it to the skin on the mesial aspect of the wound. This ensures that the mesenteric border of the loop (which forms the spur) is pulled well out of the wound and, by causing partial obstruction to the venous return, produces a solid œdema of the spur and renders it too large to recede into the abdomen, provided that the opening is sufficiently small.

The Operative Treatment of Prolapse (Procidentia) of the Rectum in Adults.

By J. P. Lockhart-Mummery, F.R.C.S.

Prolapse of the rectum in adults, while not a dangerous complaint, is certainly one of the most distressing as regards discomfort that a surgeon is called upon to treat. It causes in time complete incontinence of the fæces, and to a large extent prevents the patient from getting about or attending to any form of business. It is notorious that the results of treatment have often been very unsatisfactory, and it is quite a common thing to find that a patient suffering from this complaint has had several unsuccessful operations performed for its relief.

In principle a prolapse is similar to a hernia and requires the same conditions for its cure. In a hernia the condition is produced first by the giving way of the muscular and fibrous supports at or near a weak spot in the wall of the abdominal cavity, and secondarily by the stretching of some part of the contained viscera, which allows it to pass more or less through the opening so caused. These are also the conditions producing a prolapse of the rectum. In both conditions it is necessary, in order to cure the condition, that the prolapsed viscus shall be returned to its proper place, and if possible, anchored there, and secondarily that the weak place in the supporting wall be effectively restored. While this is a well established principle in dealing with hernia it does not seem to be so well recognized in the case of prolapse of the rectum, but in dealing with prolapse of the uterus this principle has of recent years received proper recognition.

In order to cure a prolapse of the rectum, it is necessary first of all to replace and anchor the prolapsed bowel, and then to restore the anal canal so that it is no longer a weak spot in the floor of the pelvis. It is necessary for success to secure both results, for if one only is obtained, recurrence of the condition is almost certain.

The method I am describing here was first published by me in the *Lancet* of March 5, 1910, and my excuse for describing it again is that since then I have had a much more extended experience of the operation and its results, and am convinced that it is far superior to any of the other methods.

It must be understood that the condition here referred to as prolapse does not include prolapsed piles, however bad, but true procidentia of the rectum, in which all the coats of the rectum are included in the portion which comes down. As a rule the prolapse varies in length from 2 in. to 8 in.

In old-standing cases the anus is patulous and the muscles badly stretched, while in some it may be almost impossible to elicit any contraction of the external sphincter on stimulation. If there is any appreciable weakening of the sphincter it is necessary to restore the integrity of the anus at the same time that the prolapse is dealt with, or a good result cannot be obtained. It is this factor which renders it so difficult to cure prolapse in the aged as the muscular tone in the muscles is gone, and cannot be restored. All that the surgeon can hope to do is to narrow the anal orifice. A necessary preliminary to operation is to get the lower bowel thoroughly cleared out, and several days are required to do this properly.

The principle of the operation is to restore the bowel into its normal place in the hollow of the sacrum and hold it there by firm adhesions. In order to obtain these dense adhesions I make use of healing by granulation, and with this object in view the space posterior and lateral to the prolapsing portion of the rectum is packed with gauze and only allowed to fill up slowly so as to get the densest possible adhesions between the rectum and the sacrum.

The operation is performed as follows: The rectum is thoroughly cleaned out with ether soap and lysol solution, and finally with 75 per cent. spirit and picric acid, the skin of the perineum and buttock being similarly rendered aseptic. After the prolapse has been returned a piece of gauze is placed in the rectum to prevent leakage during the operation. A transverse incision is next made about 2½ in. long, midway between the tip of the coccyx and the posterior margin of the anus. This is deepened until the connective tissue between the rectum and the sacrum is opened. With blunt dissection, or with gloved fingers, this space is opened as high up as possible and laterally, till the rectum has been freed thoroughly at the back and sides. The whole of the space thus opened up is now lightly packed with sterilized vaseline gauze 2 in. wide, and made with a sewn edge, so that it will not fray and leave particles behind. A very considerable amount of gauze tape is used, but the object is to get this spread as flat as possible and not merely to fill the pelvis with it, and so block the rectum. As much as 40 yds. of gauze have been used in some cases. The end of the gauze is left protruding from the wound and if (as is usually the case) more than one piece is used all the ends are firmly tied together at the finish. The next thing is to restore the anus, and the type of operation for this purpose will vary according to the condition to be dealt with. My usual method is to extend the ends of the previous incision forward on each side to about half way between the anterior and posterior margins of the anal orifice. The flap thus formed is dissected up so as to expose the posterior half of the external sphincter. This muscle is then carefully defined and the lateral portions sewn together from behind forwards until the anal orifice is narrowed to the extent considered desirable. No 1 catgut is used for the stitches, and they are not pulled tight enough to cut through the muscle fibres, but just to bring the sides of the sphincter into close contact. Supporting sutures are put in, and then the flap is loosely stitched back in position, room being left for the removal of the gauze packing later. A short tube is placed in the rectum to prevent prolapse should the patient strain on coming round from the anæsthetic, and the whole perineum covered with sterilized dressings.

The wound is dressed twice daily and fresh dressings applied, but the packing is not removed for a week. At the end of this time an anæsthetic is given and all the packing removed and a fresh lot of gauze introduced; this is again left in for five days or a week, when it is again removed, but this time no fresh gauze is introduced, but a drainage tube is placed in the cavity left by its removal. The wound should not be allowed to heal under three weeks, and in fact the more slowly it heals the better the result. The bowels are kept confined until the seventh day after operation, when they are relieved by an enema before the removal of the packing; after this they are opened daily with an enema, a slipper bedpan being used.

The patient is not allowed out of bed for six weeks, and not allowed to sit up for an action of the bowels for two months at least.

It is most important in view of the large area of cellular tissue opened up that there should be no sepsis at the time of the operation, but sepsis later is almost certain to occur after the removal of the packing, and is in fact desirable. The slower the wound heals and the more fibrous tissue involved, the better the result.

As regards the results of the operation, I think I may say that they are very good. The earliest case was done as long ago as 1908, so there has been plenty of time to test the question of a permanent cure. Out of the total of thirty-two cases there have only been five failures. Two of these were permanently cured by repeating the operation. In one other case two operations failed to cure the patient, but in that instance there were special circumstances. The patient, a lady, aged 52, suffered from a chronic nervous affection of the spinal cord, which caused great difficulty in micturition, and the consequent straining was the cause of the recurrence of the prolapse. She was also mentally deficient, so that it was difficult to get her to take reasonable care of herself. With these exceptions all the cases were cured. In quite a number of cases several previous operations had been performed unsuccessfully by other methods.

As regards risk, with proper precaution this would appear to be negligible. So far I have not met with any serious complication nor lost a case.

Mr. ASLETT BALDWIN said that since Mr. Mummery described his operation for prolapse of the rectum, he (Mr. Baldwin) had always used that method, with uniformly successful results. For some time past he had packed with gauze, soaked with 1 in 1,000 proflavine solution, which had been removed in about ten days; the gauze remained sweet and no further packing had been employed, so that a second anæsthetic was not necessary.

Case of Abdomino-perineal Excision (1912) followed by Ovariotomy (1920).

By Sir C. Gordon-Watson, K.B.E., C.M.G.

October, 1911: Patient, a female, aged 52, suffering from ischio-rectal abscess.

May, 1912: Motions frequent and blood-stained. Rectal pain and loss of blood.

September, 1912: Admitted to St. Bartholomew's Hospital. *Per rectum:* Nodular mass encircling bowel commencing at 3 in. from anus and not adherent to sacrum, slightly adherent anteriorly; finger can be passed into lumen, but cannot reach above the growth. Abdomino-perineal excision: Palpable glands found in meso-sigmoid up to 9 in. above reflexion of peritoneum; bowel divided 1½ in. above highest palpable gland. Microscopical sections of growth and glands: Columnar-celled carcinoma, acinous type, definitely infiltrating muscular coats. Marked mucoid degeneration of cells.

August 18, 1920: Readmitted to St. Bartholomew's Hospital with large abdominal swelling.

August 26, 1920: Large multilocular ovarian cyst removed containing 11 lb. of fluid. No evidence in the abdomen of any recurrence of carcinoma.

Case of Colostomy and Perineal Excision for Carcinoma Recti.

By Sir C. Gordon-Watson, K.B.E., C.M.G.

Patient, a female, aged 41, shown a year and a half after operation.

May 14, 1919: Colostomy and perineal excision in one stage (under gas and oxygen). Portion of posterior vaginal wall removed. Prolapse of cervix in perineal wound. Colostomy prolapse showing multiple polypi.

Case of Perineal Excision for Carcinoma of Rectum and Anal Canal, with Malignant Glands of Right Inguinal Region.

By Sir C. GORDON-WATSON, K.B.E., C.M.G.

PATIENT, a male, aged 49, shown eighteen months after operation.

April 30, 1919: Colostomy and excision of inguinal glands. Section of glands showed columnar-celled carcinoma.

May 8, 1919: Perineal excision of rectum under spinal anæsthesia.

DISCUSSION.

Mr. IVOR BACK said that the ideal operation for carcinoma of the rectum *from a scientific point of view* was the abdomino-perineal; but that at the present time the mortality of the operation was so high, even when performed by skilled operators, that the two-stage operation (colostomy with high perineal excision) was preferable, except in carefully selected cases. He had no doubt that the mortality of the abdomino-perineal operation could be reduced by improved technique and by the employment of gas and oxygen combined with spinal anæsthesia. When this was achieved it would be necessary to reconsider his opinion.

The PRESIDENT congratulated Sir Charles Gordon-Watson on the fact that the patient upon whom he had performed excision of the rectum by the abdomino-perineal method was alive and free from any signs of recurrence eight years after the operation. Such a happy result, however, was to be expected because the patient had been subjected to the complete operation whereby the tissues of the upper as well as those of the lateral and the lower zones of spread had been completely removed. Comparing operations for cancer of the rectum with those for cancer of the breast he regarded the abdomino-perineal operation as the equivalent of the complete Halsted's operation, whereas perineal excision represented a removal of the breast in which the axilla was left untouched. According to his observations on the spread of cancer from the rectum he was convinced that it was just as important to remove the pelvic mesocolon in an operation for cancer of the rectum as it was thoroughly to clear the axilla in the case of breast cancer. In this case there was evidence of metastasis having occurred in the pelvic mesocolon 9 in. above the primary growth and beyond the reach of any operation carried out from the perineum alone. There was no doubt, therefore, that if this patient had been operated upon by the perineal method she would not have been alive to-day. In regard to the two cases upon which Sir Charles had performed perineal excision eighteen months previously it was impossible to say, at the present time, whether they were free from recurrence as the mestastases, if present, were probably still in a microscopical state. In a series of eighteen cases upon which the President had performed the most complete perineal excision that it was possible to do, nothing having been left in the pelvis but the bones and the bladder, the recurrence mortality had been 94·4 per cent. The average time at which recurrence made itself manifest was twenty-seven months after operation, so that the two cases under consideration were still eleven months short of the average time at which recurrence showed itself in the series of cases alluded to. In these two cases he expected recurrence to take place in the pelvic peritoneum and in the pelvic mesocolon, as these vulnerable tissues had been left behind.

Fibrous Tumour from the Peritoneal Cavity of a Man, aged 65.

By Cecil Rowntree, F.R.C.S.

The specimen consists of one half of a tumour discovered in the abdomen of a man, aged 65, who died after an operation for strangulated ventral hernia. The tumour was absolutely free in the peritoneal cavity; there was no trace of its origin, and it was about the size and shape of a hen's egg, quite hard, perfectly smooth and lustrous on the surface, and disclosing a closely laminated structure on section. There appeared to be a central nucleus of somewhat different consistency, but microscopic examination proved the tumour to be composed throughout of fibrous tissue.

Several of these interesting formations have been described, including cases by Littré (1703), Schede (1894), and Cruveilhier (1894). When found in women, they are easily explained by supposing them to have originated in a sub-serous fibroid, but in men the problem is more difficult. There appears, however, to be a widely held belief that they may originate as the result of torsion of an appendix epiploica. If the latter be the case, then these tumours may very properly be regarded as being within the province of this Sub-section. The other half of the specimen has been deposited in the Museum of the Royal College of Surgeons.

Case of Ulceration of the Rectum.

By P. MAYNARD HEATH, M.S.

J. H., MALE, aged 43, suffered from an attack of "piles" while in the Army. He attributes it to exposure and sitting on wet seats, being an artillery driver. He reported sick several times, but nothing was done for him. He complained of severe pain in the rectum, with bleeding and discharge of pus.

When examined under an anæsthetic in October, 1919, extensive ulceration of the lower 4 in. of the rectum was found. It involved the anus and numerous fissures and tags were present. The man was sent away to the seaside and irrigations carried out, but without improvement.

In January, 1920, colostomy was performed through the left rectus muscle. The bowel at the seat of operation was healthy. Since then the patient has been much more comfortable, and has improved in general health, but the ulceration is still active and progressive, in spite of daily irrigations with various antiseptics.

The man denies all venereal disease, his Wassermann reaction is negative, and large doses of potassium iodide have no effect on the ulceration. One daughter suffers from phthisis.

Suggestions as to further treatment are requested.

DISCUSSION.

Mr. HEATH added that he regarded the ulceration as tuberculous, and that he would have a section of the edge of the ulceration prepared. He was in favour of performing a proctotomy.

Mr. ASLETT BALDWIN said that in a case of tuberculous disease of the rectum with vaginal and perineal fistulæ, which caused much misery, he performed perineal excision of the rectum and posterior vaginal wall. The condition was cured. Colostomy had been done previously at another hospital.

Mr. GRAEME ANDERSON advised free posterior proctotomy in this case to insure good drainage. At the same time the whole ulcerated surface should be freely curretted. It might be possible to obtain healing of the curetted surfaces by third intention, thus bringing about a natural occlusion of the rectum. This he had seen in a case at St. Mark's Hospital lately, where cæcostomy had been performed twenty-five years previously for ulceration following an operation for fistulæ. The cæcostomy had acted well since that time, and there was now no trace of a rectum, natural occlusion having taken place.

Section from a Tumour of the Rectum.

Shown by W. B. Gabriel, M.B.

This section was shown at a meeting of this Section on November 12, 1919.[1] Its nature was doubtful, and it was suggested that Professor Shattock be asked if he would very kindly examine and report on the specimen. This was done, and Professor Shattock writes as follows: "This is a very interesting tumour. I make it a benign growth, not arising in the mucosa, and not invading the muscular wall, and should class it as an endothelioma."

The specimen was obtained by perineal excision (Mr. Lockhart-Mummery) from a male, aged 47, who complained of pain and difficulty in defæcation for fourteen days; there had been no bleeding nor discharge from the rectum. On examination a hard, nodular growth involving the anterior wall of the rectum was felt 2 in. from the anus; it was movable; it bled slightly on examination. Carcinoma was diagnosed and the rectum was excised by the perineal method on October 20, 1919, a preliminary colostomy having been performed seven days previously. The patient was seen last in August this year and was in good health.

On examination of the specimen a firm, white, fasciculated tumour was seen in the submucous layer, with the mucous membrane apparently intact over it.

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[1] See *Proceedings*, 1919-20, xiii (Sect. Surg., Sub-Sect. Proct.), p. 14.

Section of Surgery.

President—Mr. WALTER G. SPENCER, O.B.E., M.S.

Demonstration of Cases and Radiographs illustrating the Technique employed and Results obtained in the Repair of Fractured Mandible by means of the Free Autogenous Bone-graft.[1]

By GILBERT CHUBB, F.R.C.S.

THE men I have shown this evening are from a series of ninety-five cases in which I have bone-grafted the mandible during the past two years. These cases were all operated upon at the Queen's Hospital for Facial Injuries, Sidcup. Some of them have come direct from hospital for examination and are, therefore, comparatively recent cases. The others have come from their homes, and periods varying from one to two years have elapsed since their operation.

In addition I have brought for your inspection a large number of radiograms, some of them stereoscopic, showing the pre-operative condition and post-operative appearances at various stages. Patients present have demonstrated their dental occlusion, efficient gape and lack of lateral deviation. The majority of them have claimed to be able to deal satisfactorily with any ordinary food.

In a previous publication[2] I have given a complete analysis of the first sixty cases; bony union being obtained in 93 per cent. Of the thirty-five more recent cases, four have failed to unite. Of the remainder, twenty-four up to date show firm bony union and the rest appear to be consolidating satisfactorily.

In every case the graft was obtained from the iliac crest of the same patient, and each graft was wired into the gap with as accurate an apposition as sound carpentering could obtain. The apposition was invariably an end-to-end one, the jaw fragments being trimmed so as to present plane surfaces of vascular bone tissue as far as possible facing one another.

Various factors tended to prevent this simple relationship of the facets to one another. The posterior fragment was almost invariably toothless and as a rule occupied an extremely elevated position; a deformity frequently accompanied by inward deviation and rotation, so that in addition it occupied a deeper plane to that of the anterior fragment. In the case of the latter, where the loss extended forwards to the canine region, or beyond this, it was obviously impossible to get a facet facing backwards. The sclerosis of the anterior fragment, always considerable, is usually most marked along the lower border. The removal of this region resulted in the facet facing downwards as well as outwards. The very complicated relationships in space which the facets on the two jaw fragments thus come to present to one another, necessitate a somewhat elaborate technique in order to obtain the accurate "carpentering" upon which I am convinced success depends.

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[1] At a meeting of the Section, held February 2, 1921.

[2] *Lancet*, 1920, ii, p. 9.

Models have been shown illustrating the method by which the graft is cut from the crest with terminal facets in correct relative position for immediate apposition to those of the jaw fragments. Essentially, the method consisted in obtaining a record of the positions relative to one another of the terminal facets of the jaw fragments by means of a strip of stout lead sheeting, rapidly cut and twisted so that each end lay along the long diameter of the corresponding jaw facet while its surface approached this at right angles to the place of the facet. A second strip of lead cut and twisted so that its ends approach those of the first "template"[1] gives a replica of all the essential features of the gap to be filled. The models illustrate the method by which these "templates" are employed.

In all but a few cases loss of bone extended beyond the standing teeth, and in many the ascending ramus was also involved. Cases are shown on the screen in which the loss involved the whole of the premolar and molar region and the lower two-thirds or more of the ascending ramus. In each case firm bony union was obtained at both ends, with good function. Two of the cases shown had had one bone-graft and the third case two bone-grafts, all of which had failed before the patients came under my care.

Radiograms are shown of cases which were clinically firm at the end of the third to fifth week after operation. At this period the line of apposition is still distinctly visible, but crossed by fine striæ. Radiograms of the same cases three months or more after operation showed a complete disappearance of this line. When these radiograms were viewed stereoscopically the continuity of the bone tissue across the union was readily determined.

The accurate apposition of the bones leads to rapid union. It has the additional advantage that efficient control of the posterior edentulous fragment is established. The practice has been adopted in the later cases of opening the splints two weeks after operation. The early use of the jaw results in a speedy consolidation of the primary union. Almost invariably the whole depth of the mandible is utilized in forming the facet for the graft, and the latter is fashioned of the same depth. Several cases have been shown in which the facet for articulation with the posterior fragment was 1 in. to 1¼ in. in vertical extent. In such cases two wires were frequently employed, one above the other, thus still further reducing the possibility of the accurate apposition obtained at the time of the operation being disturbed in the subsequent early use of the jaw.

The only trouble encountered from the use of the wire has been in a few cases in which skin only was available for covering the graft. In these cases the pressure of the twisted wires caused atrophy of the overlying skin many months after union had occurred. The wires were then removed. It occasionally happened that the wire was so firmly gripped where it passed through the bone that only the superficial portion could be removed. The radiograms likewise fail to show any rarefaction round the wires.

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[1] This use of the term "template" has been criticized, I think quite rightly. A "template" is a pattern, while both the lead strips described are "gauges" recording accurately the relative positions of the planes of apposition to one another, but in no cases recording the form either of the graft or of the jaw fragments. In the early cases, however, the piece of lead was actually used as a "template" of the graft, and the term was carried on while the pattern developed into the form described.

In three cases it has been possible to examine the nature of the union and to obtain sections across this region. The first section was cut in celloidin from the decalcified bone six months after operation, and has been described and figured in a previous paper.[1] The other two sections were obtained fifteen and eighteen months, respectively, after operation. These were not decalcified, but were prepared by grinding upon the finger a thin slice of bone removed with a saw. These sections, when ground sufficiently thin for mounting, could not be made to bend at the line of union, and when viewed under the microscope the latter region was seen to be composed of dense bone, the laminæ and lacunæ of which were clearly visible. The sections, moreover, were stained with Mallory's stain, which picks out fibrous tissue and stains it deep red. There was a complete absence of stain in the zone of union, while the superficial periosteal tissue in the sections was deeply stained. One of these sections was obtained owing to the necessity for resecting the posterior union in order to open the jaw; the jaw fragment being so firmly fixed by fibrous tissue as to defy movement by less drastic measures. Both in this case and in the one previously described, it could be readily determined at the time of resection that the character of the surface of the graft and its vascularity in no way differed from that of the adjacent jaw tissue. The third section was obtained post mortem, and showed the same appearances as those described in the previous section.

In all these cases the rounding off of the upper border as a result of the architectural changes in the bone accompanying use was recognized. This change in the architectural structure of the graft is also demonstrated in successive radiograms of the same case.

Meckel's Diverticulum as a Cause of Intestinal Obstruction.

By G. H. Edington, D.Sc., C.M.

The following notes illustrate the part which Meckel's diverticulum may play in the ætiology of intestinal obstruction.

Case I: Diverticulum attached to Umbilicus and ensnaring a Distal Loop of Ileum; History of Previous Attacks of Obstruction; Death from Paralytic Ileus within forty-eight hours after Operation.—M. K., aged 17, seen September 4, 1911. Two days previously seized with umbilical pain; bowels moved an hour or so later, and vomiting about same time. Repeated enemata failed to procure further evacuation. History of three previous attacks which responded favourably to enemata. Tenderness was not marked; but dullness over lower abdomen and both flanks. Median subumbilical laparotomy showed condition in fig. 1. Cæcum empty, and from it ileum traced upwards for a few inches, at which spot a thick rounded cord passed downwards and outwards across front of bowel. Externally, cord originated from gut: internally, it passed upwards and inwards behind some distended coils to the umbilicus, to which it was adherent. This vertical portion was much distended. Whole of diverticulum excised, together with adherent umbilicus. Death on second day from paralytic ileus, confirmed by post-mortem. The diverticulum arose from side of ileum to left of antemesenteric border, about 16 in. (40·6 cm.) above ileocæcal junction. Blood-supply was from mesenteric vessels and was contained in a fold which sprang from under surface of ileum some distance below diverticulum. The fold swept off from the bowel on to the mesentery, along which it pursued a curved course till it reached the upper (jejunal) aspect of the root of the diverticulum. In addition to the vessels in this fold, or meso-Meckel's diverticulum, an ill-defined vascular bundle ran along the wall of the ileum from the origin of the fold to that of the diverticulum. The fold formed with the mesentery and the ileum a deep fossa or pouch which was closed by suture after removal of the diverticulum.

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[1] *Lancet*, 1920, ii, p. 9.

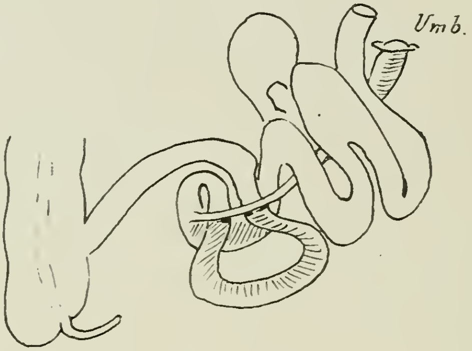

Fig. 1.

Case II : Invaginated diverticulum forming Commencement of Intussusception (Ileo-ileal, becoming Ileo-colic) ; Resection of Intussusception ; Death in twenty-four hours from Shock.—J. B., aged 10, seen June 27, 1912. Eight days previously vomiting and severe abdominal pain, passing off in a few hours.

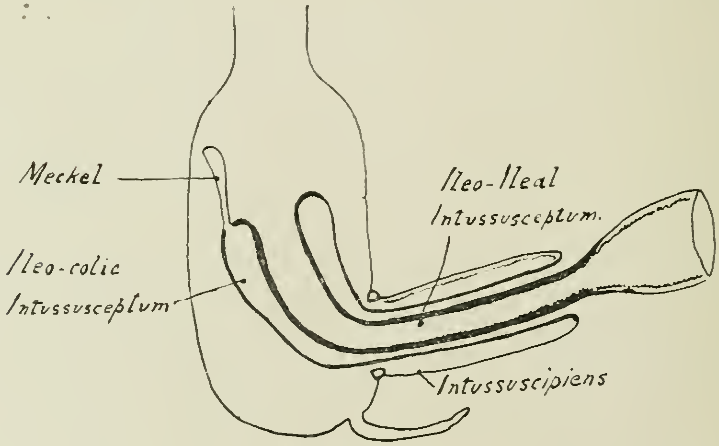

Fig. 2.

Five days later, recurrence of symptoms, and dark motion (? melæna) on following day. Rigidity of abdomen, no distension, tenderness specially marked about umbilicus; abdominal facies. Under anæsthetic, hard mass behind right rectus, about level of appendix. Laparotomy showed intussusception into lower ileum, the bulky contents of which extended for about 6 in. into ascending colon. Intussuscipiens showed patch of gangrene at commencement of intussusception. Resection and anastomosis were followed by death from shock early on the following morning. From apex of intussusceptum hung a pyriform structure, 5·5 cm. long, by 3 mm. at its origin, and 11 mm. at its thickest part (fig. 2). This on being cut open proved to be an invaginated Meckel's diverticulum.

Case III: Loop of Bowel snared by Diverticulum which had Adhesions to Mesentery; Operation; Recovery.—T. McN., aged 7, seen December 18, 1912. On night of 16th bowels moved at intervals; vomited at supper, and had severe abdominal pain. Vomiting continued irregularly; no movement of bowels after the 17th. Seemed very well during forenoon of 18th, and in evening castor oil administered. At 1 a.m. on 19th, vomited some bread which he had taken; collapse, no radial pulse, pupils dilated; very restless and pointed to left abdomen as being painful; visible coils observed. Median subumbilical laparotomy exposed loop of small gut, very dark and constricted by a Meckel's diverticulum having adhesions to mesentery. Band from tip of diverticulum divided, and some widespread translucent membranous adhesions, one of which was adherent round the gut, broken down and removed. Meckel's diverticulum excised; recovery uneventful.

Case IV: Meckel's Diverticulum attached to Umbilicus, and along with neighbouring Ileum encircling and obstructing the abnormally-free ascending Colon; Operation; Recovery.—Mrs. G., aged 37, seen February 17, 1920, with acute pain in lower abdomen of about twenty hours' duration, followed by continuous vomiting of whatever she swallowed. Good motion on 15th, none since. No history of previous abdominal troubles, but had just recovered

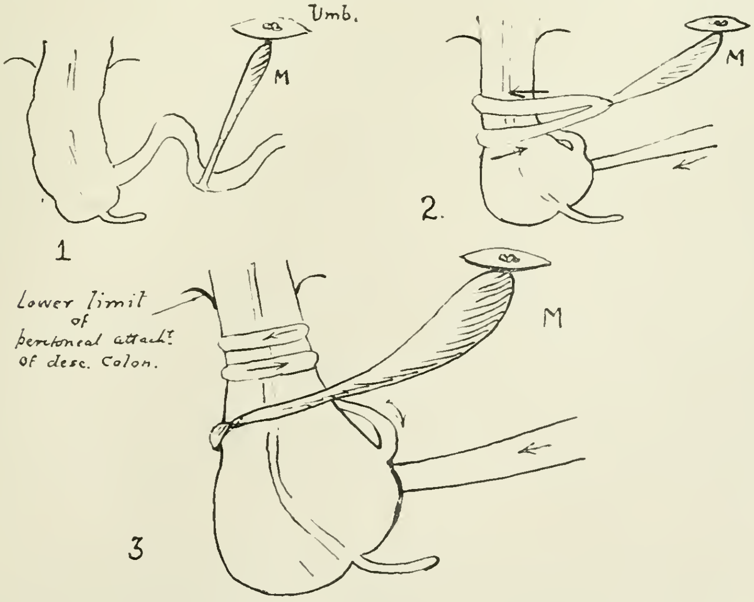

Fig. 3.

from pleurisy. Palpation greatly hindered by very marked tenderness over McBurney's point and infra-umbilical region; pulse 68 and intermittent; temperature normal; tongue clean. Abdomen quite flaccid and suggested early stage of acute obstruction rather than appendicitis. Under anæsthetic there seemed to be a bulky swelling behind lower half of right rectus. Transverse laparotomy, as for appendicectomy [1], demonstrated greatly distended cæcum, with normal appendix. Swelling behind rectus was caused by a Meckel's diverticulum forming firm bluish sausage-like structure extending up to umbilicus, to which it was adherent. At lower end diverticulum passed downwards and outwards over front of colon, was narrowed, and showed axial twist (fig. 3). For better display of parts, right rectus was cut across and a double course of small intestine found tightly encircling colon above level of diverticulum. Umbilicus (which resembled a prominent rosette) and adherent end of diverticulum were freed and brought down inside abdomen, and out through laparotomy wound. Two turns of it "against the clock" freed colon completely from the encircling bowel and the diverticulum. The diverticulum arose about 12 in. (30 cm.) above ileocæcal junction, and from close to mesenteric attachment, and there were many old peritonitic adhesions and resulting fossæ in neighbouring mesentery. Cæcum and lower half of ascending colon had a complete investment of peritoneum, rendering them abnormally mobile. The Meckel's diverticulum was removed, and wound closed without drainage; recovery uneventful.

REMARKS.

These cases exemplify not only the usual anatomical details of the diverticulum, free or attached, but also the occurrence (Cases III and IV) of peritonitic adhesions, and resulting pouches.

As regards the mechanism of the obstruction, Cases II and III present no difficulty: in the others it is rather more complicated. In Case I the contracted proximal portion of the diverticulum seemed to act as a band under which a loop of bowel had passed; but in addition several loops had passed forwards over the diverticulum and lay between it and the anterior abdominal wall. It is difficult to explain the mechanics of the obstruction in this case. Possibly in the first stage the passage forwards of the ileum over the Meckel's diverticulum made the proximal part of the latter taut and so allowed of the constriction of a loop lower down near the origin of the diverticulum. If this were the sequence of events it would be fair to consider the obstruction as due partly to *volvulus* and partly to *band.*

In Case IV the steps in the production are a little more difficult to follow. There was an abnormally mobile colon and cæcum which seemed to have travelled inwards behind the diverticulum and then passed down in front of its proximal part. Repetition of this manœuvre led to the relationship of parts found at the time of operation. There was no torsion of the colon; but the narrow proximal part of the diverticulum showed a very distinct twist. This case must therefore, I think, be looked upon as one of *volvulus*, the portion of gut concerned (ileum and Meckel's diverticulum) moving with the clock.

SYMPTOMATOLOGY.

There is little in the symptomatology to distinguish these cases from those of acute obstruction generally. It may be remarked, however, that the *seat of tenderness* is usually on the right side, at the level of or just below the umbilicus, leading to confusion with appendicitis. Halstead [2] mentions that where the diverticulum is attached to the umbilicus Bérard [3] laid great stress on the exquisite sensitiveness of the umbilical region. This sign was marked in Case IV, and contrasted with the usual signs of appendicitis; but it was also noted in Case II, in which the diverticulum had no attachment to the umbilicus.

While the presence of *other congenital malformations* might give a clue, their absence means practically nothing. In Halstead's review of sixty-nine cases, harelip was present in one only; the remainder showed no malformations. They were absent in the present series, with the very doubtful exception of a puckered umbilical scar in Case IV.

TREATMENT.

These cases, presenting as they do the signs of acute obstruction, or simulating acute appendicitis, naturally call for immediate operation. The obstruction having been relieved, the diverticulum should be excised. And, in excising, care must be taken not to "borrow" too freely on the wall of the bowel and so cause a narrowing of its lumen. This precaution must be all the more observed because of the narrowing of the bowel which frequently already exists at the seat of origin of the diverticulum.

SUMMARY.

The points illustrated by the present series of cases may be summarized as follows:—

Age.—7, 10, 17, and 37; average $17\frac{3}{4}$ years.

Sex.—Male, three cases; female, one case.

Attachment.—Absent, 1 case. Present—to mesentery, one case; to umbilicus, two cases (total, three cases).

Form of Obstruction.—Band, one case; volvulus, one case; band and volvulus, one case: invagination and intussusception, one case.

History of Previous Attacks.—One case.

External Malformations.—(?) One case.

REFERENCES.

[1] Edington, *Brit. Med. Journ.*, 1914, ii, p. 459. [2] Halstead, A. E., *Ann. of Surg.*, 1902, xxxv, p. 471. [3] Bérard et Delore (ref. Halstead), *Rev. de Chir.*, 1899, xix, p. 745.

Section of Surgery.

President—Mr. WALTER G. SPENCER, O.B.E., M.S.

On a Further Series of 500 Goitre Operations, with Special Reference to After-results.[1]

By JAMES BERRY, F.R.C.S.

IT is, in my opinion, the duty of every surgeon who enjoys unusual opportunities of performing large numbers of any particular surgical operation, to publish from time to time details of his cases with, so far as he can, an accurate record of his results, both immediate and remote. Any complications that have occurred, any improvement or alteration in his practice, any mistake that has been made—in short, any lesson that he has learnt from the study of his cases—should be made available for the benefit of others who have to deal with similar cases.

In the following pages I propose to give, as far as space will allow me, an account of all the cases in which I have removed any portion of the thyroid gland during the period from January 1, 1913, to December 31, 1919. These operations, 500 in number (Nos. 752-1251),[2] form a direct continuation of previous series which have been already published.[3]

The eighty-seven operations which I have performed from the beginning of 1920 up to the present time, being too recent for my present purpose, have not been included in this series, although I make use of one or two of these to illustrate special points.[4] On the other hand, twenty-four cases of operation for exophthalmic goitre performed during 1913 and already published in detail in the *British Journal of Surgery*[5] are necessarily included in the present series.

(I) SEX- AND AGE-INCIDENCE.

TABLE I.—SEX- AND AGE-INCIDENCE OF THE SERIES OF 500 CASES (NOS. 752-1251 INCLUSIVE).*

Males		Females	
15-19 years inclusive	6	14-19 years inclusive	26
20-29 ,, ,,	12	20-29 ,, ,,	95
30-39 ,, ,,	8	30-39 ,, ,,	139
40-49 ,, ,,	10	40-49 ,, ,,	119
50-59 ,, ,,	16	50-59 ,, ,,	45
60-69 ,, ,,	4	60-69 ,, ,,	13
70-75 ,, ,,	7	70 and over	0
Total males	63	Total females	437

* These numbers refer to operations for the removal of goitre, and form part of a consecutive series from the year 1888, when No. 1 was performed.

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[1] At a meeting of the Section, held January 5, 1921.

[2] Performed upon 496 patients; one malignant, one exophthalmic, and two others having been operated upon twice.

[3] *Proc. Roy. Soc. Med.*, 1907, December; *Trans. Med. Soc. Lond.*, xxxvi; *Lancet*, 1913, March; and elsewhere.

[4] The figures used to illustrate this paper are also, in some instances, taken from cases before or after the present series, as will be seen from the accompanying reference numbers. Owing to war troubles (want of preserving fluid and jars, and other reasons), a large number of the actual specimens of this series including some of the most important, were thrown away without my knowledge.

[5] *Brit. Journ. Surg.*, 1914, i, No. 4, p. 699.

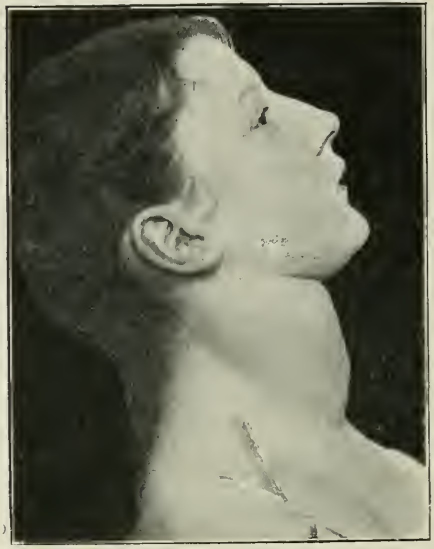

Fig. 1.—No. 1776. Parenchymatous goitre causing dyspnœa. Female, aged 14. Resection-extirpation of right lobe. Weight of portion removed 7 oz.

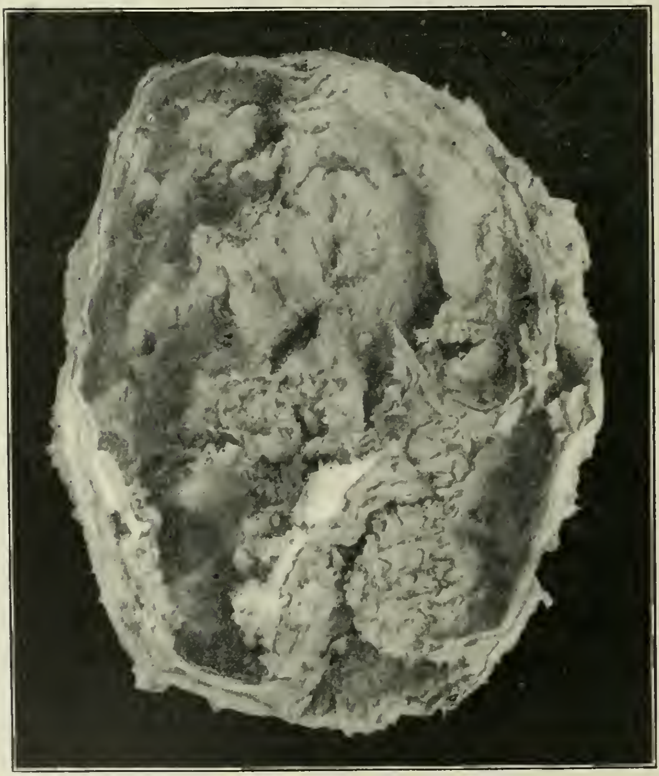

Fig. 2.—No. 103. Old cystic adenoma with thick fibrous and calcified wall. Interior was filled with broken-down blood-clot and colloid. Removed from a doctor, aged 60. (Royal Free Hospital Museum, xxii, 48.)

The youngest patients were five girls aged 14, the subjects of parenchymatous goitre, rapidly growing, causing dyspnœa, and failing to respond to medical treatment. In all cases the goitre was of considerable size: in one the portion removed weighed 11¼ oz.; all made good recoveries and are quite well now.

Operations in children below the age of puberty are hardly ever necessary, and on account of the danger of interfering with subsequent growth and nutrition they should never be undertaken except for some very urgent reason.

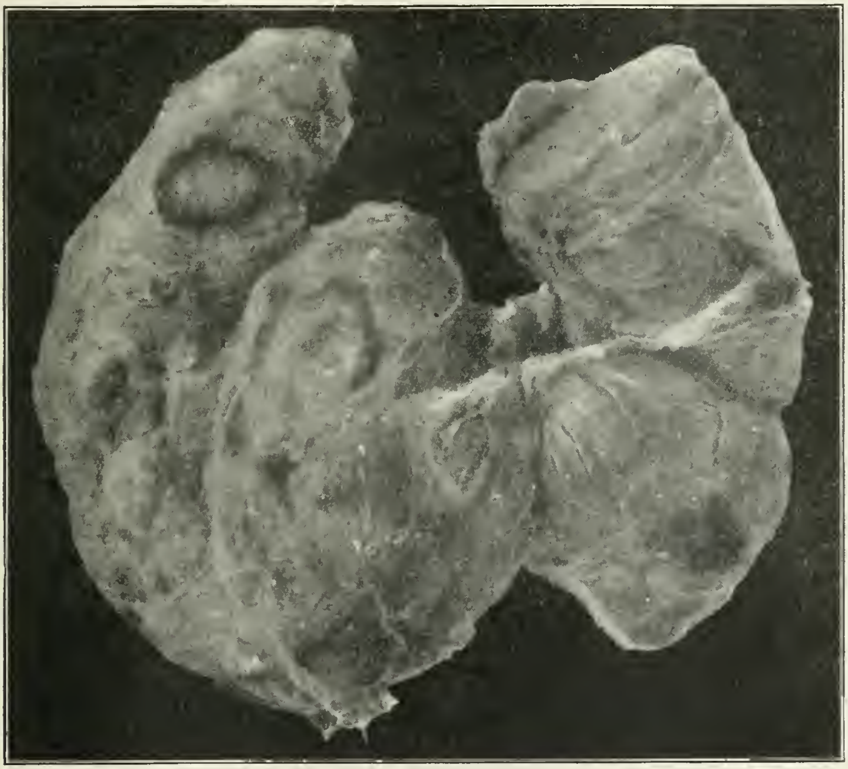

FIG. 3.—No. 1306. Parenchymatous goitre causing dyspnœa. Male, aged 15. Right lobe and about two-thirds of left removed. Weight 8¾ oz.

Operations for mere deformity in children are in my opinion quite unjustifiable. On the other hand, parenchymatous goitres at or about the age of puberty and later, if growing rapidly and causing really serious stridor and dyspnœa, often urgently demand operation if they do not yield to medical treatment. The trachea in such cases is so soft that it can easily be fatally occluded by a double goitre, especially if the lower part of the latter be situated low down behind the sternum, as it so often is.

The youngest among the male patients were two boys, aged 15; the cases were exactly similar to the preceding.

The oldest female patient in this series was a lady, aged 66, with dyspnœa and tachycardia, from whom an old, partly calcified, adenoparenchymatous goitre weighing 4 oz. was removed, with complete relief.

Among the male patients, seven were 70 years of age or over: all made good recoveries; in most of these the tumours were large and unilateral, with much displacement of the trachea and larynx. One of these patients, aged 74, had first consulted me thirteen years previously on account of a cystic tumour as large as an orange, but had postponed operation until a huge tumour occupied the whole of the right side of the neck, displacing the larynx and trachea so much that he had had alarming attacks of suffocation, which drove him to operation. The thick-walled cyst, which was removed without difficulty, contained a pint of brown, porridge-like material, a mixture of colloid and old blood-clot with much cholesterin.

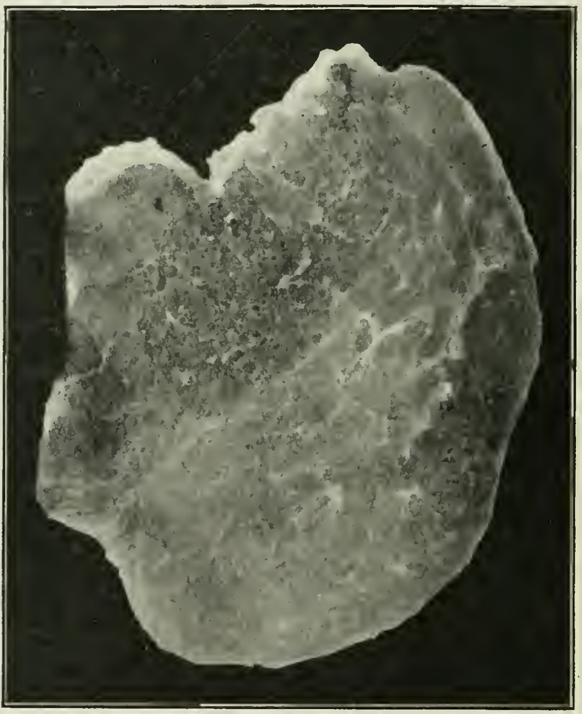

FIG. 4.—No. 1313. Portion of a parenchymatous goitre causing dyspnœa. Female, aged $14\frac{1}{2}$. Extirpation of right and lower half of left lobes. Weight $6\frac{1}{4}$ oz. Shows commencing fibrosis and much reduction of colloid from prolonged previous medical treatment.

The oldest patient of the series, a minister, aged 75, was operated upon nearly five years ago for a retroclavicular goitre causing much stridor and dyspnœa. The tumour weighed over half a pound. The patient is now hale and hearty at 80. Another patient, a man aged 73, with a solid, largely calcified, adenomatous mass of many years' duration, weighing $22\frac{1}{4}$ oz., is in excellent health at the age of 80. His wound healed *per primam*, the highest temperature after operation having been 99·8° F.

The removal by resection-enucleation of these large prominent unilateral tumours in old people is, in my experience, a very satisfactory operation. The tumours are often old tough-walled cysts; the removal involves but little interference with the thyroid gland tissue itself; the vessels are usually very easily secured; provided the strictest attention be paid to asepsis, to the complete arrest of all hæmorrhage—even the most trifling oozing—and the wound be drained for at least a few hours, the results are very satisfactory.

(II) PROPORTION OF HOSPITAL TO PRIVATE CASES.

TABLE II.

Hospital cases:—	Male	29	
	Female	227	
			256
Private ,,	Male	34	
	Female	210	
			244
		Total	500

It will be seen from the above table that the numbers of hospital and private patients were about equal, nor was there, on the whole, much difference between the severity of the cases in the two classes. Only among the exophthalmic goitres did the hospital cases (fifty) considerably exceed the private (twenty-nine), doubtless owing to the fact that hospital patients are less able to afford prolonged rest and medical treatment, and therefore come earlier and more readily to operation.

(III) NATURE OF THE GOITRE.

TABLE III.

Encapsuled:—		
Solid adenoma	88	
Cystic	109	
Pure cyst	1	
		198
Non-encapsuled:—		
Parenchymatous	70	
Adenoparenchymatous	137	
Inflammation (acute or chronic)	3	
True exophthalmic	79	
Malignant and papilliferous	13	
		302
	Total	500

It may be admitted at once that the above classification is, pathologically, not strictly accurate; but it is convenient clinically. The term "parenchymatous" used here for the uniform enlargement of the gland with distension of all the vesicles—the commonest goitre of young people—is a well-established term difficult to replace by any more exact, and pathologically more correct, expression.

The term "adenoparenchymatous" is used loosely for the more lobulated, and often nodular, goitres of middle-aged and elderly people in which, embedded in the midst of parenchymatous goitre-tissue, there are encapsuled masses of atypical thyroid tissue, sometimes solid, but often breaking down into cysts. Sometimes these masses are true adenomata, more often they are not.

"Pure cyst" is a term used for a single cyst with smooth lining like a hydrocele, a somewhat rare condition compared with the much more common form of cyst which is formed by the breaking down of a previously solid encapsuled adenoma, the remains of which can generally be seen adhering to the interior of the cyst wall. The distinction is clinically of some importance, since it is the soft vascular tissue in the interior of the common thyroid cystic adenoma that is so likely to give rise to intracystic hæmorrhage, occurring spontaneously or after slight injury.

In a large number of the encapsuled tumours removed there was abundant evidence of recent or old hæmorrhage having occurred before operation. But this very rarely occurs in parenchymatous goitre.

It is usually quite easy to make a differential diagnosis between encapsuled and non-encapsuled thyroid tumours, a matter of much importance as regards the question of operation. On the other hand, to say definitely that an encapsuled tumour is wholly cystic or wholly solid, or partly one and partly the other, is usually impossible; but from the point of view of operative interference this is a matter of comparatively little importance, since both have to be treated in a similar manner.

The three cases of inflammation are of sufficient interest to be given in detail.

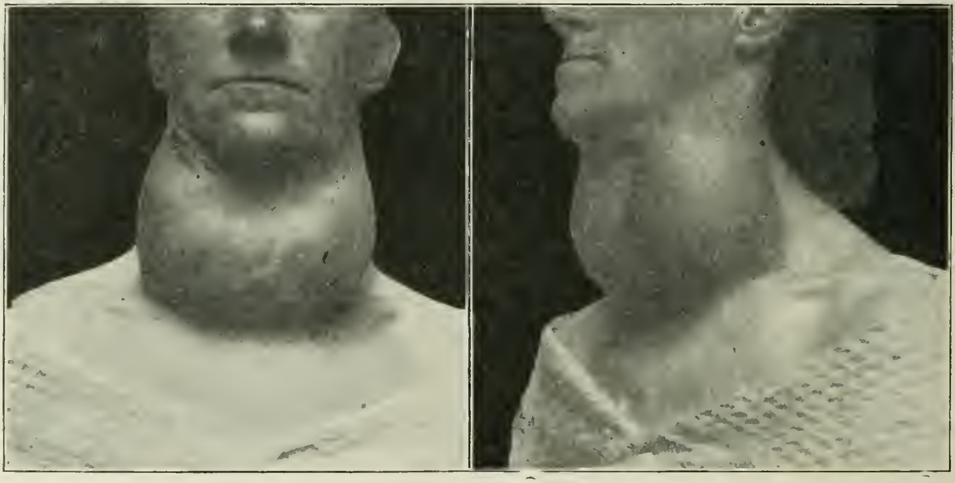

FIG. 5, *a* and *b*.—No. 1238. (*a*) Parenchymatous goitre, thirty years' duration, with some adenomata. (*b*) Side view. Treated by bilateral resection-extirpation. Nine-tenths of right lobe, three quarters of left. Weight, 22 oz.

Case 1.—A suppurating cyst, as large as a small walnut, in a lady, aged 37; only a few days prior to operation she had first noticed a smooth, hard, movable swelling in the neck, the most prominent feature being pain. On removal it proved to be an old cystic adenoma containing thin purulent fluid; the tumour was freely removed, the wound drained for two days, and a rapid recovery ensued. Two and a half years later she wrote to say that she had been quite well ever since.

Case 2.—A married lady, aged 36, who had had a rounded lump in the neck for about two years. It was about as large as a pigeon's egg, and as she gave a history of its having varied a good deal in size, it was thought to be an ordinary cystic adenoma. As it was not causing any trouble, I at first advised against any operation; but as she came back later complaining of a good deal of pain, the tumour was removed. It proved to be a solid, non-encapsuled mass involving the whole of the left thyroid lobe, which was removed. It consisted almost entirely of chronic inflammatory tissue of a pale yellowish colour, without colloid and without any evidence of actual suppuration. The wound healed apparently *per primam*, and she left the home at the end of a week. Subsequently suppuration occurred, and the wound had to be reopened on two occasions; it did not finally heal until two months after the operation.

In neither of these cases was the cause of the inflammation clearly ascertained.

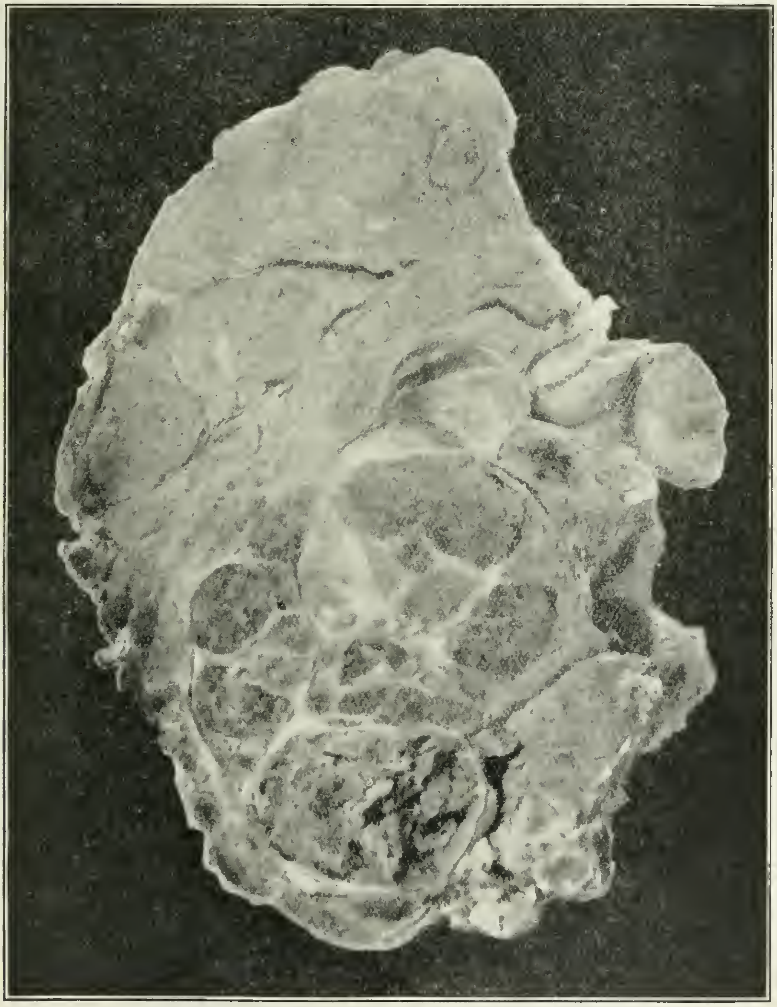

FIG. 6.—Section of part of preceding.

[*Photos. by Miss G. Matthews.*]

Case 3.—This case was that of a lady doctor, aged about 46, who underwent removal of the right thyroid lobe for what was probably an early stage of so-called "canceriform" primary chronic inflammation (Riedel's disease). The patient came complaining of a painful lump in the neck of two months' duration. It was obviously

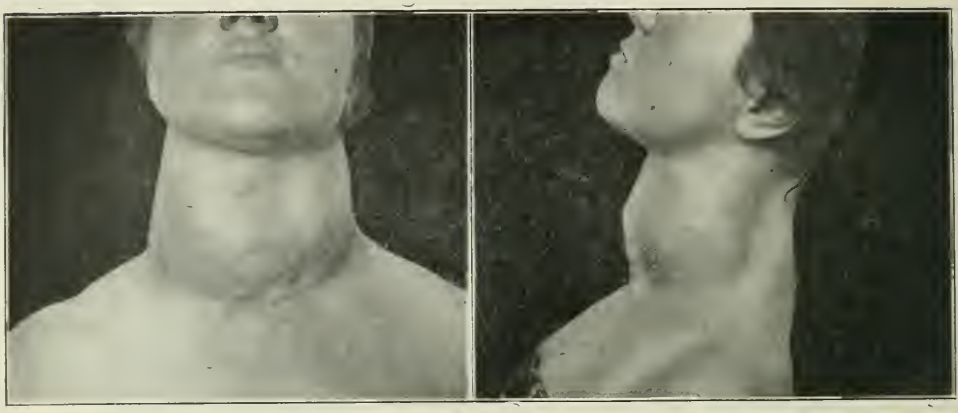

Fig. 7, *a* and *b*.—No. 993. (*a*) Adenoparenchymatous goitre, causing dyspnœa and considerable distension of veins at root of neck. Female, aged 27. (*b*) Side view. Extirpation of right lobe. Weight 12¼ oz. Six years later remaining lobe had enlarged considerably.

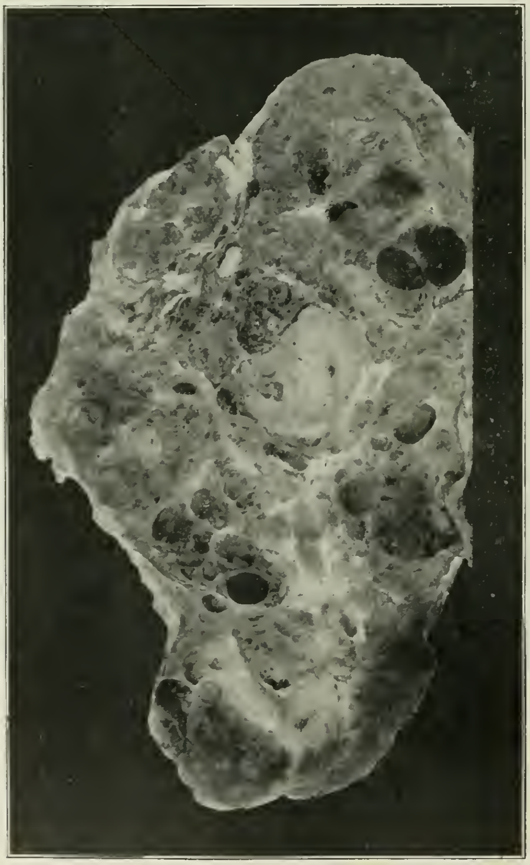

Fig. 8.—Section through goitre removed from preceding. Lobulation and fibrosis more advanced than in fig. 4, No 1313. Solid adenomatous masses in various parts.

thyroid, and not much larger than a hazel-nut. It was hard and knobby, and did not move quite so freely upon the larynx as an ordinary innocent tumour of the thyroid should. There was no dyspnœa, dysphonia, or dysphagia, and the only symptom was a certain amount of pain on both sides of the neck. It was thought to be probably a small cyst in the middle of an old and hitherto unnoticed goitre, especially as two other members of her family were known to have goitres. But in view of the serious possibility of the case being one of early malignancy, the right lobe was removed, the operation presenting no difficulty of any kind.

The pathological report (by Dr. Helen Chambers) was: "The outer surface is smooth and somewhat white and opaque. On section, the tissue is white and firm, and contains numerous white, narrow, fibrous strands passing through it in all directions. No colloid can be seen. The macroscopic appearance suggests a chronic inflammatory condition of the thyroid gland. On microscopic examination no normal tissue can be found. The section shows chronic inflammatory changes, and it is certainly not a malignant growth. . . . . The cause of the inflammatory condition is not evident."

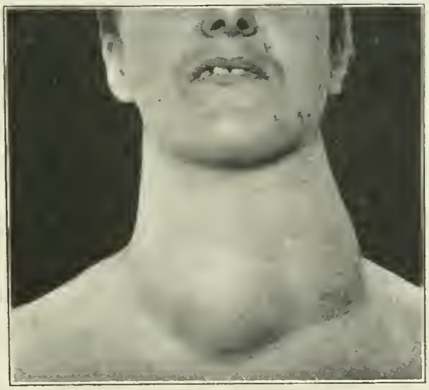

FIG. 9.—No. 948. Adenoparenchymatous goitre causing dyspnœa. Female, aged 37. Bilateral resection-extirpation. Weight 18 oz.

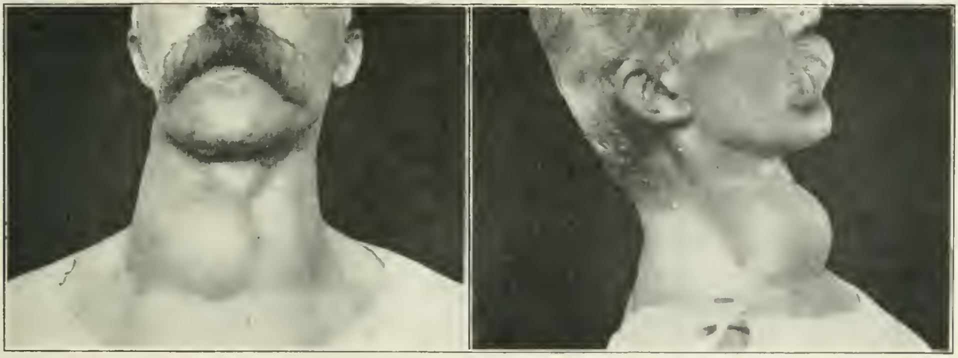

FIG. 10, *a* and *b*.—No. 989. (*a*) Old parenchymatous goitre causing dyspnœa. Male, aged 50. (*b*) Side view. Extirpation of most of left and lower half of right lobe. Weight 8¾ oz.

The opposite lobe appeared to be quite healthy. The wound healed at once. Five months later the patient wrote that she had been quite well ever since the operation. Three weeks ago (six and a half years after the operation) she wrote from abroad that her "health has been and is excellent," and that there is no sign of any recurrence. She adds the interesting note that a sister of hers, who had had a goitre since childhood, has recently died of malignant disease of the thyroid.

True Exophthalmic Goitre.—In this class (seventy-nine operations on seventy-eight patients) have been placed only those cases in which not only the clinical symptoms, but also the naked-eye and microscopic appearances of the disease were quite characteristic. There was, however, one doubtful exception in which for some unexplained reason the pathological report received apparently failed to confirm the clinical diagnosis, which appeared to admit of no reasonable doubt.

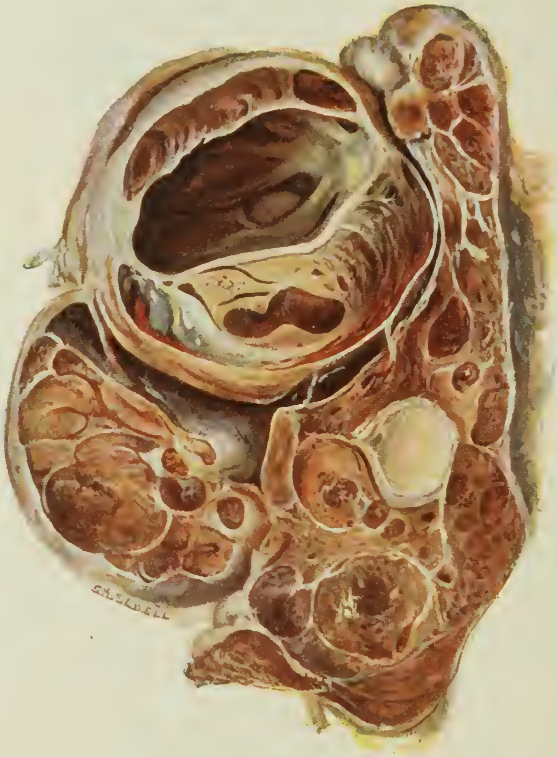

FIG. 11.—No. 262. Adenoparenchymatous goitre removed for dyspnœa. At upper pole is a well-encapsuled cystic adenoma. Female, aged 42. Weight 6 oz.

Cases of "false" exophthalmic goitre, that is, of tachycardia, tremor, &c., without exophthalmos, and mostly with unilateral tumours, have been rigidly excluded from this class. In some of these cases, the apparent symptoms of Graves' disease, especially the palpitation and tachycardia, would appear to have been caused by long-continued and excessive administration of thyroid-gland preparations. The inclusion of such cases among those of true exophthalmic would be, in my opinion, quite misleading, although it is often done.

Malignant and Papilliferous.—This group of twelve patients (thirteen operations, one patient with papilliferous carcinoma having been operated upon twice within the period) includes tumours of very different degrees of malignancy, from papilliferous carcinoma and one endothelioma, with histories extending over several years, to a suppurating sarcoma with a total duration of six months. Two were sarcomata, one was not definitely determined, and the rest were carcinomata.

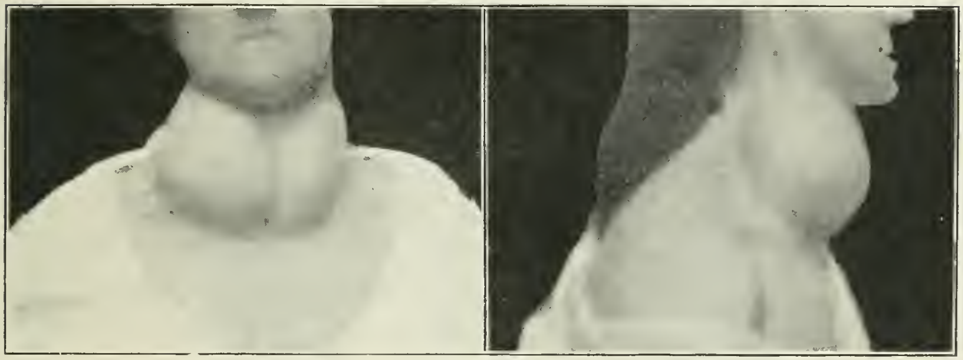

FIG. 12 *a* and *b*.—No. 1261. (*a*) Adenoparenchymatous goitre, twenty-eight years' duration. (*b*) Side view. Bilateral resection-extirpation for bulk, deformity, and dyspnœa. Female, aged 48. Weight 19 oz. [*Photos. by Miss B. Rickard.*]

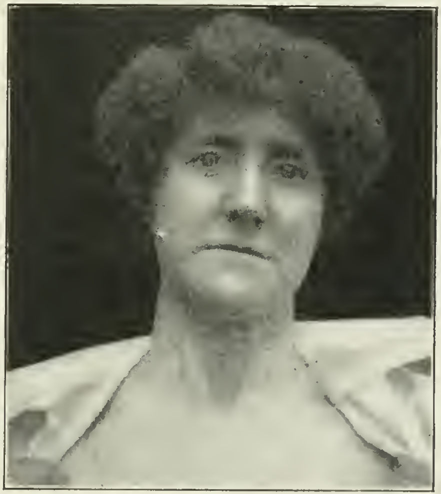

FIG. 13 *c*.—The same patient as in fig. 12, one year after operation.

(IV) PRINCIPAL REASONS FOR OPERATION.

TABLE IV.

Dyspnœa	274	of which	1 died	
Discomfort, deformity, and slight dyspnœa ...	99	,,	0 ,,	
Deformity	17	,,	0 ,,	
True exophthalmic goitre	79	,,	3 ,,	
Malignant and papilliferous	13	,,	2 ,,	
Suspected malignancy	5	,,	0 ,,	
Primary chronic inflammation	1	,,	0 ,,	
Palpitation, nervousness, &c.	12	,,	1 ,,	(glycosuria)
Total	500			

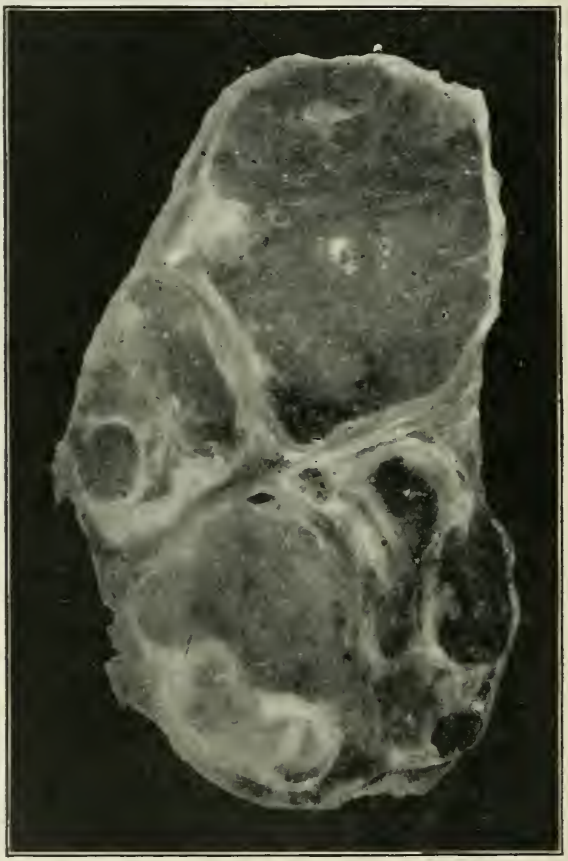

FIG. 14.—Section through right lobe of No. 1261 (figs. 12 and 13), showing much old fibrosis.

Dyspnœa.—It will be seen by the table that by far the most common and important reason for which operation was undertaken was dyspnœa. I have never declined to attempt the removal of any innocent goitre on account of the mere severity of the dyspnœa; in many of the cases there was a very high degree of dyspnœa; often it had existed for years and led to serious

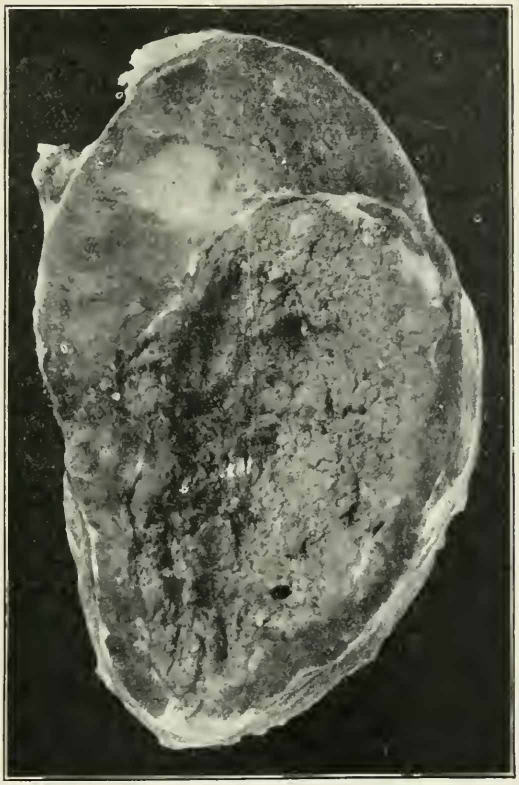

FIG. 15.—Section through left lobe of the same, showing a large cavity which contained broken-down blood-clot and colloid.

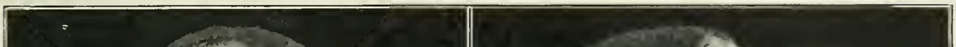

FIG. 16, *a* and *b*.—No. 867. Female, aged 25. (*a*) Typical exophthalmic goitre, four years' duration. (*b*) Side view. Treated by extirpation of right lobe.

complications, such as dilatation of the heart, tachycardia, and chronic lung complications. Many of the patients were quite unable to lie down, and had to be operated upon in the semi-recumbent position. In the great majority of cases the dyspnœa was not so extreme, although practically always enough to cause

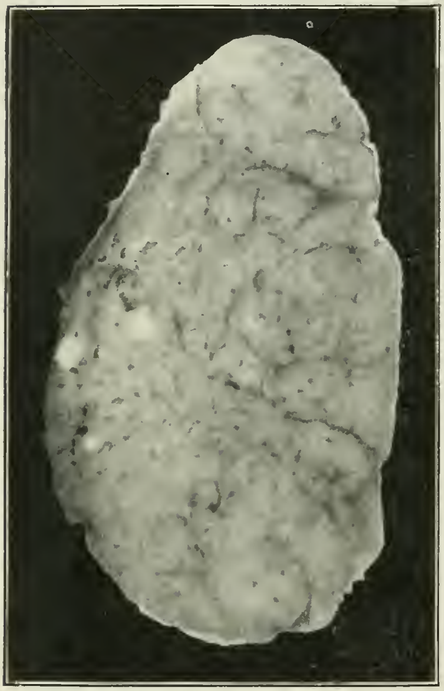

Fig. 17.—Nos. 1029 and 1315. Typical exophthalmic goitre removed from lady, aged 29. Weight 4 oz.

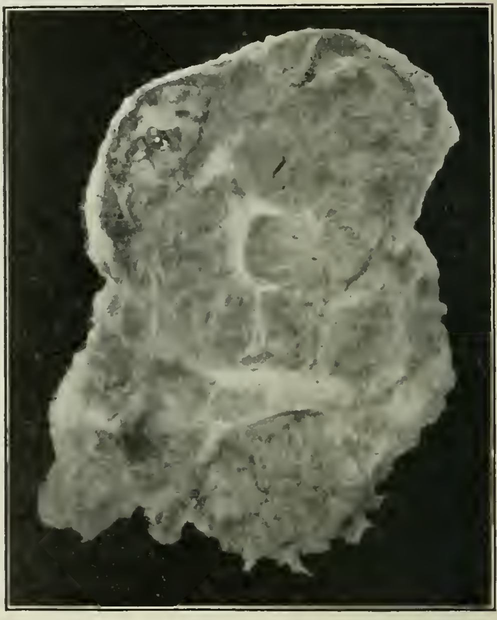

Fig. 18.—No. 1265. Part of a papilliferous carcinoma removed from a man, aged 57. (Royal Free Hospital Museum—Ea. Pb. 402.)

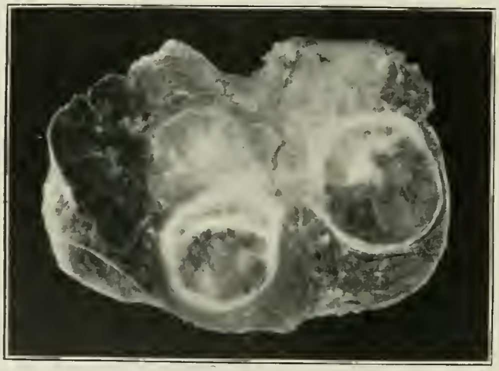

Fig. 19.—No. 1140. Spheroidal-celled carcinoma removed from a female, aged 65. (Royal Free Hospital Museum—Ea. Rb. 426.)

the patient considerable distress. In this series there has been no such theatrical case as that of the girl, aged 14, upon whom in 1901 I had to do a hurried bilateral extirpation as she lay in bed, quite unconscious from impending suffocation, which had supervened suddenly in the middle of the night.[1] On the other hand, I have to record an unfortunate case, which is not in this series, although it ought to have been, and I wish it had been. It was that of a man, aged 20, admitted to the Royal Free Hospital, February 3, 1914, with a large soft parenchymatous goitre of five years' duration, which for eighteen months or more had caused gradually increasing dyspnœa. It was thought that he would improve and be in a better condition for operation after a day or two of rest in bed, as such cases usually are. He passed a fairly comfortable night, but in the early morning sudden suffocation occurred, and he was dead before even the house surgeon could reach him. In this case it was an error of judgment on my part not to have operated directly I saw the patient, in which case I should doubtless have saved his life. The goitre,

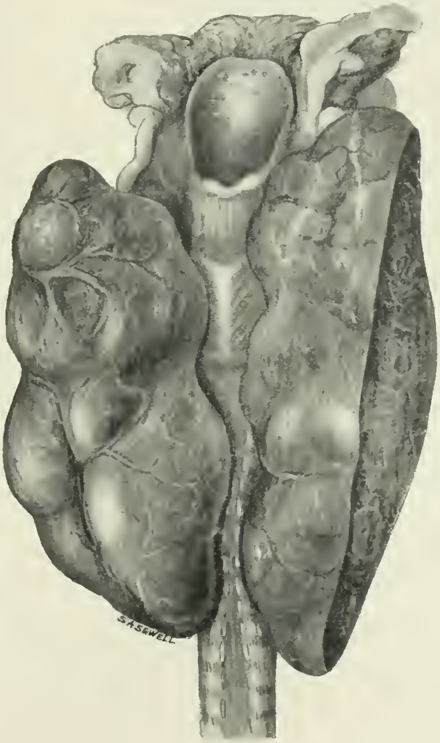

FIG. 20.—View from behind of a large parenchymatous goitre with larynx and trachea, showing the usual scabbard shape of compressed trachea. From a man with chronic dyspnœa, aged 20, who died of suffocation suddenly in his bed, before any operation had been attempted.

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[1] Case 136, *Lancet*, 1902, i, 1227, and *Proc. Roy. Soc. Med.*, 1907, i (Surg. Sect., November 12), p. 39. The patient has recently been seen by me and is in excellent health.

which is seen from behind in fig. 20, was symmetrically bilateral and purely parenchymatous, the lateral lobes just meeting behind the pharynx and œsophagus. The trachea was compressed laterally in the usual manner for nearly 2 in., the lumen being a mere chink. The goitre, after removal from the body together with the larynx and trachea, weighed 26¾ oz.

In no case during this period of seven years have I performed a tracheotomy for innocent goitre, holding as I do very strongly that removal of the source of pressure, namely the goitre, is a far more satisfactory proceeding than mere tracheotomy. There are, of course, cases in which the operator, owing to circumstances which preclude the possibility of doing a clean thyroidectomy, may be compelled to attempt a tracheotomy under conditions of extreme urgency.

Tracheotomy for suffocating goitre is apt to be a difficult proceeding, and far more dangerous to life, owing to septic complications, than a clean thyroidectomy performed under proper conditions. The trachea is often deeply buried under the mass of goitre; it may be much displaced and difficult to find; the constricted region of the trachea may be, and often is, behind the sternum. The dyspnœa of goitre being due, not to spasm of the larynx, but to direct pressure upon the trachea, is not relieved by merely opening the larynx or the upper part of the trachea. It is generally quite impossible to reach the trachea below the constriction, and if the trachea be opened above it, an unusually long tube (such as Koenig's), which is not always at hand, must be employed. Our museums and surgical literature abound in illustrations of futile attempts to perform tracheotomy under such conditions. When it has been successfully performed, the mortality is considerable, and the patient still has the goitre pressing upon his trachea.

In cases of high degree of dyspnœa the operator will nevertheless do well to have tracheotomy dilators and a long tube at hand in case he may have to use them during the performance of the operation. There have been awkward moments during many of the more severe of my operations, especially during the dislocation of the tumour, when it has seemed that tracheotomy might become necessary. Even after the goitre has been removed, there is sometimes a danger of tracheal collapse. I have occasionally had to watch a flattened trachea for some little time after removal of the goitre before I ventured to close the wound over an unopened trachea. Fortunately many of the most severe cases of acute dyspnœa occur in young subjects with bilateral compression, in whom the trachea still retains much of its normal elasticity. In such cases the flattened trachea very quickly recovers from its compression. In older people recovery is much more slow, but the degree of compression is usually not so great.

An important point may here be insisted upon, which is, that in the case of bilateral compression of the trachea, the removal of one lobe alone may be quite insufficient to relieve the dyspnœa, indeed may even make it worse. The bilaterally-compressed scabbard-shaped trachea, so long as it remains in the middle line, may permit the passage of sufficient air to keep the patient alive. But remove one lobe, and the opposite lobe immediately pushes the trachea away from the middle line, bends it, and produces a kink which may easily lead to a fatal suffocation.

I would venture to lay down a rule that in cases of bilateral goitre with high degrees of dyspnœa, it is often dangerous to be content with a unilateral operation. After one lobe, or the major portion of it, has been removed, the operator should always examine the condition of the trachea and of the opposite lobe very carefully, and be prepared if necessary to remove also the lower portion of the latter. Much depends naturally upon the degree of stenosis, and the skill and judgment of the operator.

Another point with regard to dyspnœa which is sometimes overlooked, but which is of much practical importance, is this, that it is by no means the most prominent or the most obvious portion of the goitre that is the real cause of the dyspnœa. There are many cases in the present series in which an obvious, prominent, apparently unilateral goitre was considered by the patient, and sometimes even by his doctor, to be the cause of the severe dyspnœa from which he was suffering. Nevertheless in these cases it has often been the *opposite* lobe that has been the real offender, and which is the one that requires removal, lying deeply, perhaps even wholly unsuspected, behind the sternum or in the thorax. The key to the position in such cases is to be found in a careful examination of the root of the neck, where the top of the offending mass can often be felt; or in observation of the exact position of the trachea, displaced away from the source of pressure. In some cases an X-ray examination, if it can be obtained, may be most useful, showing as it may do,

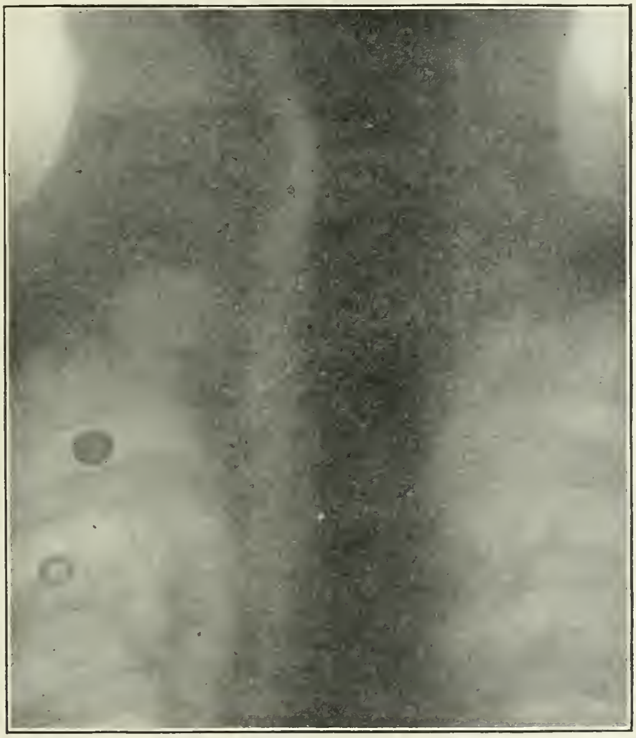

FIG. 21.—No. 1338. Skiagram of a comparatively small left-sided, almost wholly intrathoracic goitre, showing the trachea which appears as a band of light, displaced to the (patient's) right. In the neck a right-sided goitre bends trachea slightly to left in an S shape. Male, aged 54. (*See* also figs. 22 and 23.) Skiagram was taken the day before removal of the intrathoracic portion. which weighed 6 oz.

not only the deeper portion of the goitre, but the position of the trachea, which shows up as a band of light in the skiagram. An inexperienced operator may easily remove the wrong half of the goitre.

If a parenchymatous goitre in a young subject—that is a goitre uniformly enlarged in all parts—presents one lobe which is much more prominent than the other, it is nearly always the *least* prominent, that is the deeper, lobe that most urgently demands removal. Similarly in older subjects, if a large rounded prominent mass fairly high up in the neck is accompanied by serious dyspnœa, it will often be found that the true cause of the dyspnœa lies in an enlargement of one or other inferior horn which lies jammed in the upper opening of the thorax. A typical example, from among many, may be cited:—

A retired merchant, aged 70, was sent to me in 1918 with a history that for several years he had had some difficulty in breathing, together with tachycardia. Both symptoms had become much worse in the last few months. Recently he had been treated for "heart disease" in a nursing home for twelve weeks without much benefit. A *right*-sided goitre as large as a hen's egg, fairly high up in the neck, was then supposed to be the cause of his trouble, and it had been suggested that the removal of this would benefit him. When, shortly afterwards, he came to me, it was obvious that the real cause of all his trouble was an old *left*-sided goitre jammed in the upper opening of the thorax. The top of this could easily be felt when the head was extended and the goitre thus drawn up. His heart, examined for me by Dr. Strickland Goodall, showed the usual dilatation so often seen with chronic goitre, extreme irregularity, and auricular fibrillation. After giving him a few days' rest in bed in a nursing home and some treatment with digitalis, I removed the left-sided intrathoracic goitre, about as large as an orange. It had evidently been there for many years, as it was largely fibrotic. The recent enlargement was due to the accumulation of some fluid within it. The patient made a rapid recovery, and was able to leave the home a fortnight after the operation, with his wound soundly healed. His heart gradually recovered its tone, and he is now in good health with a regular quiet pulse. He is able to rush about the country and make long political speeches without effort.

Discomfort, Deformity, and Slight Dyspnœa.—In this group, which comprises one-fifth of all the cases, are included those in which the goitre, mostly unilateral, was removed partly on the ground of discomfort produced by pressure, and partly because of the deformity, often very considerable. Really severe dyspnœa was not present in these cases, although in many of them the steady growth made it probable that serious dyspnœa would occur later if no operation were undertaken. In most of them slight dyspnœa occurred on exertion, and many had other symptoms such as tachycardia, palpitation, dysphagia, and various nervous symptoms. It was noticeable that many of these patients, who before the operation had not complained of dyspnœa, volunteered afterwards the remark that they could breathe much better than before. A large number also stated that, besides enjoying freedom from local symptoms, their general health had improved very much. Those who were below the normal weight before the operation—and most patients with such goitres are thin—usually regained it afterwards. In this group comes the patient from whom the largest goitre in the whole series was removed. He was a young man, aged 21, who had had for several years a gradually enlarging parenchymatous goitre which caused him much discomfort, mainly from its bulk and weight. Nearly the whole of the right lobe, together with four-fifths of the left, were removed without difficulty. The total weight of the parts removed was 3 lb. 0$\frac{3}{4}$ oz. (right, 27$\frac{1}{2}$ oz., left 21$\frac{1}{4}$ oz.). He made a rapid and excellent recovery, and was subsequently for three years on active service in the Army, which he has only recently quitted. Fig. 24 shows his condition some three or four years after the operation.

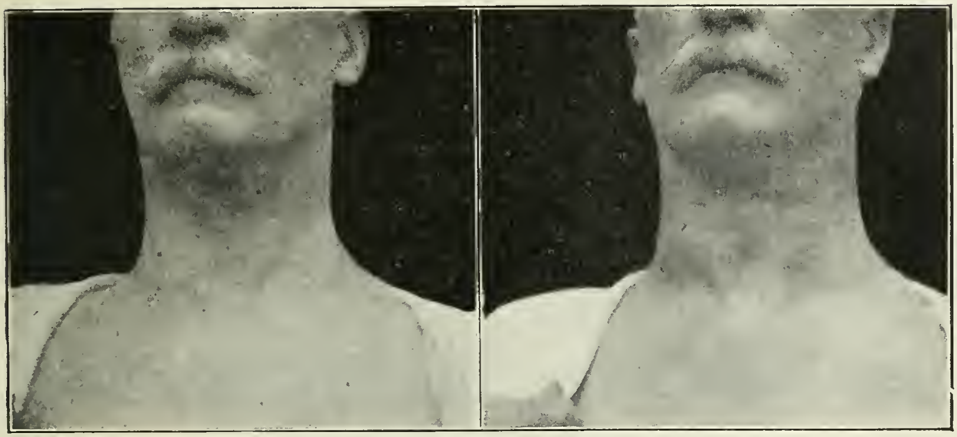

FIG. 22, *a* and *b*.—No. 1338. Bilateral goitre, right side cervical, left side almost wholly intrathoracic. Male, aged 54, who had suffered for some years from increasing paroxysmal dyspnœa. (*a*) Condition when at rest. (*b*) Condition when straining, the top of the intrathoracic portion then rising into the root of the neck.

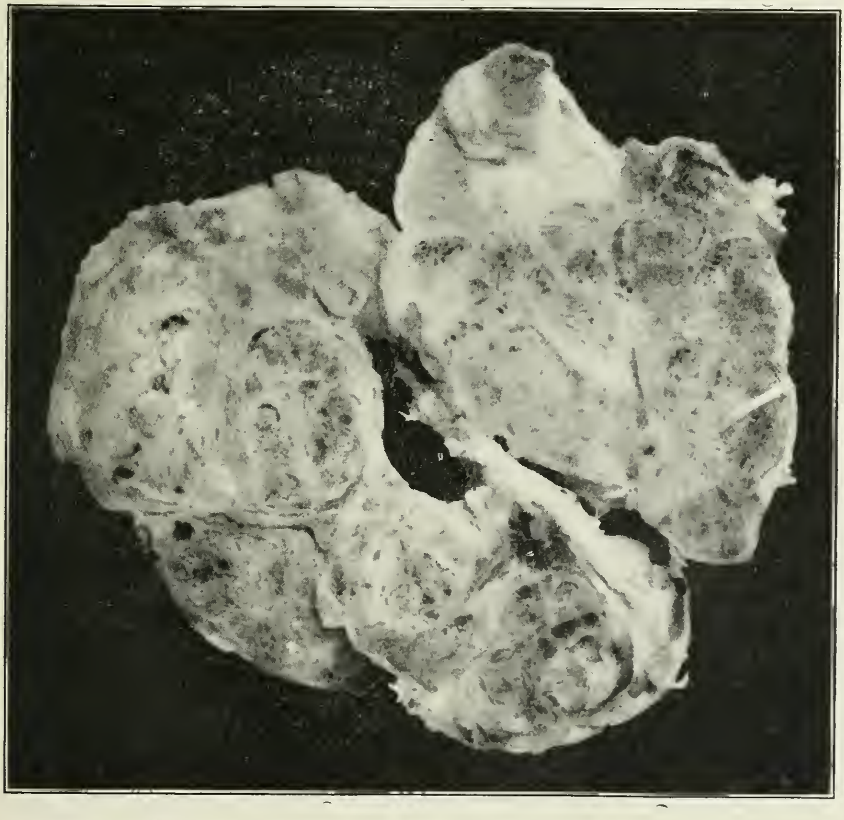

FIG. 23.—No. 1338. Left-sided intrathoracic tumour removed by extirpation from the preceding. Adenoparenchymatous, with some calcification of lower horn. Weight of intrathoracic portion 5½ oz.

Deformity.—In seventeen cases only was the operation done mainly for deformity (hospital cases five, private twelve). Two patients were men, the rest women. All except four were under 40 years; of these, one was a man, aged 50, with a very unsightly lump as big as a golf-ball, situated directly in front of the larynx; the other a man, aged 73, with a very large mass which weighed 22 oz. after removal. All the tumours were unilateral, and most were of various sizes from that of a walnut to that of a goose's egg. In all cases the wounds healed by primary union, and the patients were all quite well when last seen and heard of, one only three months, the rest from two to seven years, after the operation. Operation is never performed for mere deformity for small or moderate-sized parenchymatous goitres. Such cases are best treated by medical means, which should include a search for, and if possible removal of, the primary source of trouble.

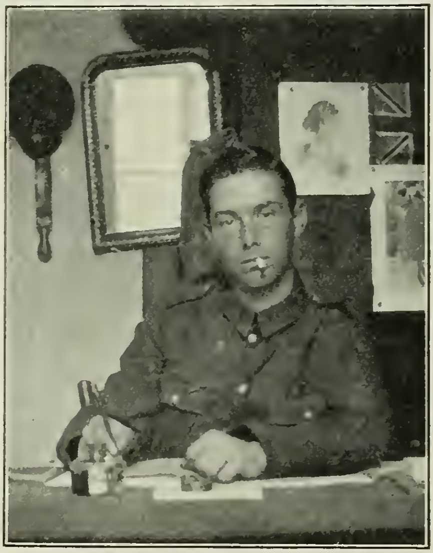

FIG. 24.—No. 1019. Patient, aged 24, about three years after bilateral extirpation for discomfort, bulk, and weight of a parenchymatous goitre weighing 3 lb. $0\frac{3}{4}$ oz. (The largest of this series.)

True Exophthalmic Goitre.—The reason for operation in all these cases was the existence of well-marked clinical symptoms of Graves' disease, and not the presence of the local trouble. Marked dyspnœa was not present in any case, and even slight dyspnœa was wholly absent from most. It is not necessary to dwell further upon the well-known symptoms of the disease, to which, moreover, allusion has already been made in the preceding section.

Malignant and Papilliferous.—In this class have been placed together, for convenience, all cases which were proved to be of this nature, although the principal reason for the operation was not necessarily a definite diagnosis of malignancy. In one case of a large solid adenocarcinomatous tumour, for instance, dyspnœa was the primary cause of the operation; in another it was pain; in the third it was the presence of spontaneous suppuration that demanded operation. Out of a large number of cases of malignant disease seen during the period, only twelve cases were submitted to operation. One case of papilliferous carcinoma underwent two operations.

Suspected Malignancy.—The five cases of this group were all elderly people (three women, two men), whose ages were from 46 to 61. All had comparatively small tumours, with a history, sometimes afterwards proved to be erroneous, of short duration. None were definitely diagnosed as malignant ; indeed in none was it thought that malignancy was very likely to exist. But in each case there was some point which made it very difficult to say that the case was not one of an early stage of malignancy, and it seemed better to subject the patient to the trivial risk of a small and easy operation rather than to leave the tumour, especially as all the patients were alarmed and anxious for operation. In one case it was paralysis of the sympathetic nerve and slight dysphagia, in another unusual hardness and irregularity, in another a small hard lump at the back and inner part of the gland causing discomfort and pain, in the other two hardness with very short history, that led to the operation. All made excellent recoveries and are known to be quite well at the present time.

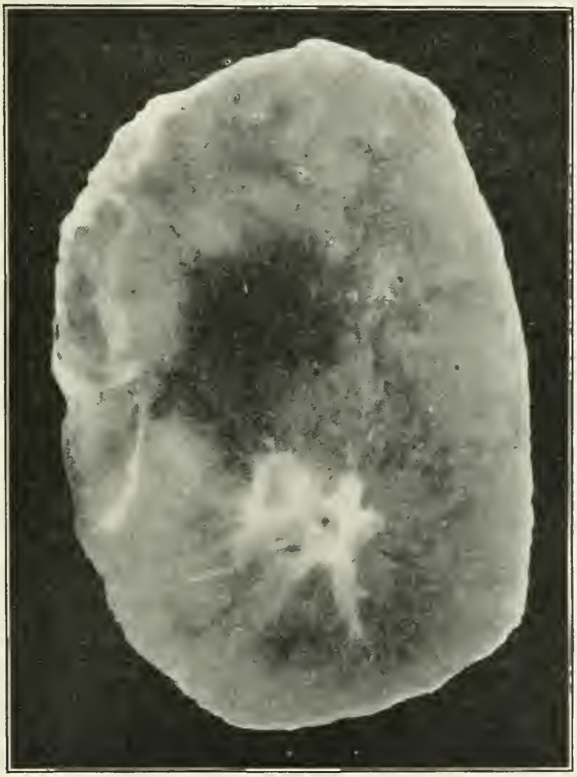

FIG. 25.—No. 1275. Solid adenoma showing the common star-shaped central fibrous mass, with commencing calcification. Weight 9¼ oz. Female, aged 43. Removed on account of discomfort and slight dyspnœa. (Royal Free Hospital Museum—Ea. Cg. 9030.)

During the same period many cases have been sent to me with a diagnosis or a suspicion of malignancy in which I was able to state definitely from the physical characters of the tumours, and the history, that the disease was non-malignant and that no operation was necessary. In none of these cases, so far as I am aware, did malignancy subsequently develop.

There is another important class of case, however, that deserves special mention. It is not uncommon for an elderly patient with a large, often bilateral, hard, and somewhat fixed goitre to give an indefinite history of the occurrence recently of symptoms such as slight pain, slight enlargement, or some vague feeling of discomfort which raises a suspicion, but merely a suspicion, of the supervention of malignancy. In such cases, in the absence of any of the more definite signs of malignancy, such as recurrent laryngeal paralysis, marked dysphagia, adhesion to neighbouring structures, &c., it may be impossible to say more than that the disease may possibly be malignant. In such cases of elderly patients whose general health is quite good and who are not suffering from any local trouble due to the goitre, it is generally unwise in my opinion to subject them to what must necessarily be an extensive and severe operation which will probably prove to have been quite unnecessary. Frequently the symptoms are due to the development of a small cyst or a little hæmorrhage in the depths of the tumour, for which it is quite unnecessary to do any large operation.

In a certain number of such cases there may really be malignant disease, and, if it could be diagnosed with certainty, even a large and dangerous operation would be quite justifiable. The treatment must depend upon the judgment and experience of the individual surgeon, the severity of the proposed operation, and the probability of the patient being really benefited by it. For it must not be forgotten that sometimes very extensive malignancy exists without any pain or any of the other ordinary clinical manifestations. The disease may be found to be wholly inoperable owing to infiltration of the deeper structures, while the patient's general health is still perfectly good. To operate on such a case often means putting the patient at once into a condition of grave discomfort and danger from which he will probably never recover. If not operated upon, he may enjoy many months or even a year or two of comparative health and comfort.

A very important point to consider before undertaking an operation for the removal of a supposed undoubted malignant goitre is whether the gland moves, not only on swallowing, but *also upon the larynx and trachea*. Many a malignant goitre which moves quite freely up and down with the larynx and trachea will be found at the operation to be so hopelessly incorporated with the trachea, and possibly also with the œsophagus, as to render satisfactory removal out of the question and the operation perfectly futile. On many occasions I have known want of attention to this point to have induced young surgeons (including myself, in the past) to embark upon useless and unjustifiable operations which had much better not have been attempted.

Out of many cases that illustrate the above points I will cite briefly two:—

Case 1.—In March, 1919, a lady, aged 72, who had had a goitre for at least twenty-five years, was brought to me because she thought that in the last three months it had grown a little larger, and had caused a little discomfort. There was no loss of flesh, no dysphagia, dysphonia, or dyspnœa, nor any other certain sign or symptom of malignant disease. The thyroid presented itself as a very hard bilateral mass low down in the neck, each lobe being as large as a hen's egg. The mass moved freely with the larynx and trachea, but could not be moved freely upon the trachea. I told the doctor that there was a very strong suspicion of malignancy in this case, although I could not be absolutely certain, as there was no definite evidence of the tumour having altered in size or consistency for many years. and that it was possible that it might be merely an old calcified or fibrotic goitre of long standing. What was quite certain, however, was that " whatever it is, no operation is desirable: if it is malignant operation is out of the question on account of the extent of the disease; if it is non-malignant, no operation at all is necessary." Two months later the tumour was a little larger. but the feeling of discomfort had almost gone. The diagnosis of carcinoma was now fairly certain. From time to time I heard of her, that she was able to get about and enjoy life. but that the tumour was slowly growing, although causing no fresh symptoms.

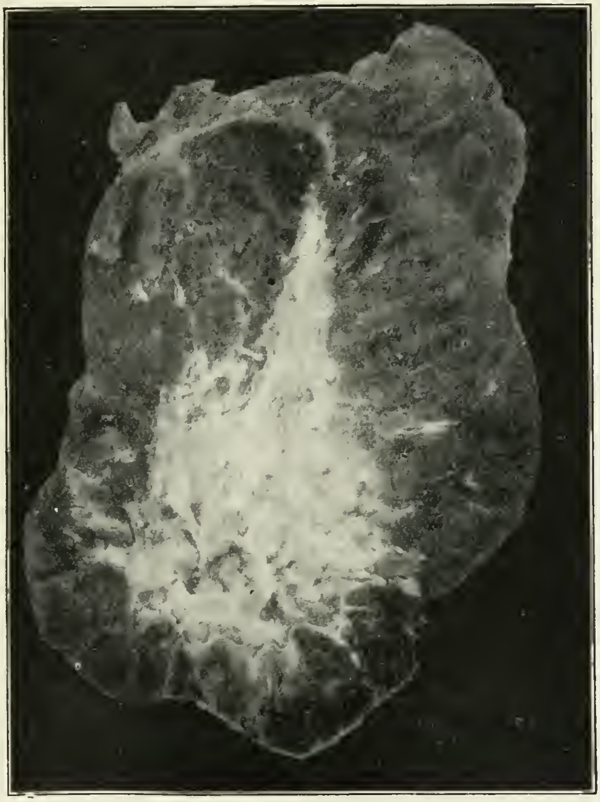

FIG. 26.—No. 1256. Left lobe bilateral adenoparenchymatous goitre showing extensive central calcification. Female, aged 47. Partial bilateral extirpation for increasing bulk and discomfort. Weight 12½ oz. (Royal Free Hospital Museum—Ea. Cg. 9035.)

In October, 1920, nineteen months after I first saw her, she was brought to me again. She was still able to get about, and was not suffering to any great extent. The tumour had now grown to the size of a man's fist. It was irregularly hard and knobby; the carotid artery was not palpable. There was still no dysphagia or dyspnœa, but there was a little irritative cough. The general condition was still good, but the patient was pale, and it was evident that she was beginning to fail. I heard from her doctor recently that a few weeks later she got very rapidly worse, and that she died just a week ago, twenty-one months after I first saw her, without having had any serious suffering or discomfort until within the last few weeks. The post-mortem showed an extensive carcinoma.

On the other hand, a year later, in March, 1920, an almost exactly similar case was brought to me by another doctor.

Case 2.—This patient was a lady, aged 59, who had had a bilateral goitre for many years—at least seven—and, according to her husband, probably about twenty years. For about three months she had complained of some laryngitis and cough, but she had no pain, dysphagia, or dyspnœa. Both lobes of the thyroid were enlarged, on one side to that of a hen's egg, on the other to twice that size; as in the previous case, the tumour was low down in the neck; it moved freely with the trachea, but not upon it. The carotid artery could easily be felt on one side but not on the other. This was the most definite point in favour of malignancy. As before, the diagnosis lay between old adenoparenchymatous goitre and malignancy supervening upon an old innocent goitre, although in this case I was inclined to take a somewhat more hopeful view of the case, in spite of the condition of the carotid artery. My notes record that "if the tumour is malignant, curative operation is out of the question; if innocent, the symptoms are not bad enough to demand operation." It was arranged that she should see me again in three months' time, or sooner if necessary. Before the expiration of that time, however, I heard that she was dead. On making inquiries, I learnt that, upon the advice of a friend, she had subsequently consulted another surgeon who had been bold enough to advise and to attempt removal, which was performed six weeks after I saw her. The doctor has kindly given me a full account of the operation, which presented great difficulties. "Owing to the isthmus being very adherent, in raising this, the trachea got torn . . . . a fœtid bronchitis supervened," and the patient died of this six weeks later. The removal was stated to have been "probably incomplete." It is only fair to add that I am informed that in the interval which elapsed after I saw the patient dyspnœa seems to have developed, and some such operation as tracheotomy may have been desirable. But on the other hand the condition, which was hopelessly inoperable as regards any prospect of cure when I saw the patient, is not likely to have been any more favourable six weeks later. The case is one which young and confident operators will do well to remember.

Primary Chronic Inflammation.—The case showing this condition has already been fully described in Section (III).

Palpitation, Nervousness, &c.—The twelve cases included in this class are instances of what, for want of a better term, I am in the habit of calling "false" exophthalmic goitre. They are very common. Many others presenting similar symptoms might also have been placed here, but have been put under dyspnœa, or elsewhere, since this was the main reason for the operation. These cases, although often classed as "exophthalmic goitre," ought, in my opinion, not to be so called. They do not develop exophthalmos, although they may present nearly all the other symptoms of that disease; the gland after removal does not present the appearances characteristic of that disease. What is still more important, operations upon them do not carry with them the same risk, or anything approaching the risk, of the operation for true Graves' disease.

I am not speaking of the so-called Basedowified goitre, cases in which to an old simple goitre have been added all the signs and symptoms of true Graves' disease. Such cases, in my experience not very common, are really cases of true Graves' disease, and are accompanied not only by exophthalmos, but by the characteristic pathological appearances of that disease, which are seen in the gland side by side with the evidence of the old pre-existing goitre, whatever its nature.

The cases in the class which I am now describing are ordinary goitres, generally unilateral, often simple adenomata or cysts, sometimes parenchymatous, but which do not present exophthalmos or the pathological appearances of Graves' disease. The term "thyrotoxic" adenoma is often applied to them but I am not at all sure that the theory which this name implies is a correct one, although it may be. What is important clinically is that the removal of the tumour, which is generally a simple operation, and practically as safe as that for ordinary goitre, will usually result in the patient quickly losing all her unpleasant symptoms and being completely restored to health, which is by no means always the case after operations for true exophthalmic goitre.

There are, of course, exceptional cases which are difficult to classify, especially in the early stages, but on the whole the three groups that I have mentioned are fairly well defined and easily separable from each other.

The following may be cited as a typical example of the class of "false" Graves' disease :—

No. 957.—Mrs. H., aged 35, had had for ten years a right-sided goitre, and for five years had been subject to palpitation. She had had no serious dyspnœa, but had lost weight considerably of late. There was no exophthalmos, and she had not had diarrhœa. The heart was slightly dilated and the pulse quick and irregular. In July, 1914, the tumour was removed by resection-enucleation without any difficulty. It was an ordinary encapsuled adenoma as large as a hen's egg, and weighed $2\frac{1}{4}$ oz., five-sixths solid, the rest consisting of clear fluid. The pathological examination showed no signs of true Graves' disease. The wound healed by first intention, and the patient went home on the nineteenth day after the operation. When seen again two months later she both looked and felt much better. She had gained weight and lost her palpitation, although she still had some tachycardia and slight cardiac irregularity ; she stated that her heart gave her less trouble than before. In September, 1920 (six years later), her husband writes me from the country that "the operation was a complete success, as she has not had signs of any trouble since."

(V) NATURE OF OPERATION.

TABLE V.

Extirpation	190	
Resection-extirpation	119	
Extirpation and enucleation	4	
Extirpation and resection-enucleation	1	
		314
Enucleation	13	
Resection-enucleation	168	
Resection-enucleation and enucleation	5	
		186
Total		500

Operations performed :—	Right side	252
,, ,,	Left side	135
,, ,,	Bilateral	83
,, ,,	Right side and isthmus	21
,, ,,	Left side and isthmus	8
,, ,,	Not known	1
	Total	500

Of the figures in this table it is not necessary to say much. It will be seen that the extracapsular operations of extirpation and its varieties greatly exceed the intracapsular operation of enucleation and its varieties. Among the latter it will be noticed that pure enucleation is now but rarely performed, having been almost wholly superseded by the much better operation of resection-enucleation, in which the thinned and degenerated layer of glandular capsule is removed together with the tumour (fig. 28). This leaves behind a much smaller surface of wounded gland.

One sometimes hears surgeons speak of the "shelling out of a *lobe*," in my opinion a most dangerous proceeding. The principal danger of the shelling out (enucleation) of even an encapsuled tumour, to which alone this operation is applicable, is that of penetrating the posterior, and often very thin, layer of investing glandular capsule, and causing serious venous hæmorrhage or damage to the recurrent laryngeal nerve. If the shelling out of a whole lobe—that is, an extracapsular operation—were attempted, it would be scarcely possible to avoid most serious venous hæmorrhage. Pure enucleation is now reserved almost entirely for cases of quite small and superficial encapsuled tumours enclosed in a relatively thick layer of fairly healthy thyroid-gland tissue. If this table be compared with the similar table in which I gave, in 1913,[1] the statistics of my previous series of operations (Nos. 401-751), it will be seen that in the earlier series the enucleation class of operation comprised four-sevenths of the total number, while in the present series it comprises only a little over one-third. In other words, intraglandular operations are being replaced more and more by extracapsular ones, but these are never " shelling-out " operations.

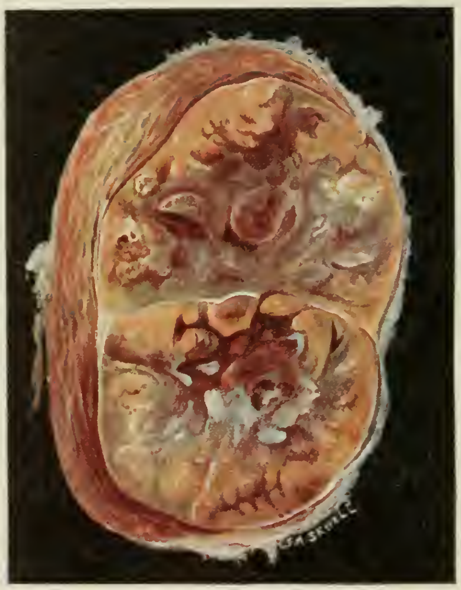

FIG. 27.—No. 223. A well-encapsuled solid adenoma (fœtal type) covered by thick layer of compressed but otherwise fairly normal gland-issue. Female, aged 36. Removed by resection-enucleation.

Total extirpation of even one whole lobe is, however, now but rarely performed by me, except for malignant disease, and in a few other exceptional cases.

A portion of gland, usually about as large as a normal lobe, is practically always left at the hilus, or " dangerous area " as it has been called. I consider this to be a great improvement on earlier practice. Total removal of the whole thyroid gland I have never performed in the whole of my practice. I consider it to be an entirely unjustifiable proceeding, never necessary even for malignant disease, and still less for exophthalmic goitre.

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[1] Lettsomian Lectures, *Trans. Med. Soc. Lond.*, vol. xxxvi.

The combined operation (e.g., extirpation and enucleation) refers of course to the different treatment of the opposite sides of the gland at the same operation.

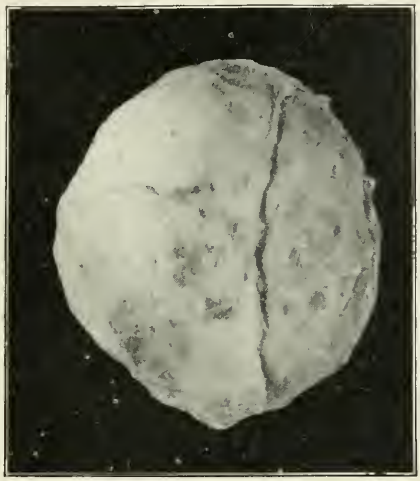

FIG. 28.—Encapsuled solid adenoma after removal by resection-enucleation. Surface of tumour proper is seen on the right, that of thin investing layer of thyroid gland on left.

(VI) INTRATHORACIC GOITRE.

TABLE VI.

Patients	22
Operations	22
Males (average age 51 years)	8
Females (average age 43 years)	14
Unilateral operations	17
Bilateral	5
Parenchymatous	6
Adenoparenchymatous	11
Solid adenoma	4
Cystic	1
Weight in ounces or size (male)	Orange, orange, 12, 9¾, orange, orange, 8, 4
,, ,, ,, (female)	?, ?, 11½, 8, 3¾, ?, 7½, 28, 6¾, 5, 7, 6¼, 12, 12
Primary union	17
Sinus—few days to few weeks	5
Complete recovery	22

As a general rule it may be stated that the lower down in the neck a goitre is situated, the more likely it is to produce serious or dangerous dyspnœa. Many goitres, especially unilateral ones, are situated behind the inner end of the clavicle or upper border of the sternum, and becoming jammed between these parts and the projecting vertical column, displace and flatten the trachea obliquely, thus causing severe dyspnœa. To these the terms retroclavicular and retrosternal[1] goitre may be applied.

But in many cases the goitre descends still lower, below the level of the first ribs, thus lying partly or even wholly within the thorax proper. If enlargement and consequent tracheal pressure take place in this situation, the term *intrathoracic* is applicable.[2]

The goitre may be wholly intrathoracic or only partly, the upper part forming an obvious swelling in the neck (fig. 29). Any kind of goitre may be intrathoracic, but in the great majority of cases the goitre does not become intrathoracic, or at any rate is not diagnosed as such, until the patient has reached middle age. Adenomata, cysts, and other more or less encapsuled masses in connexion with old adenoparenchymatous goitres are therefore much more common than the purely parenchymatous form. Occurring thus

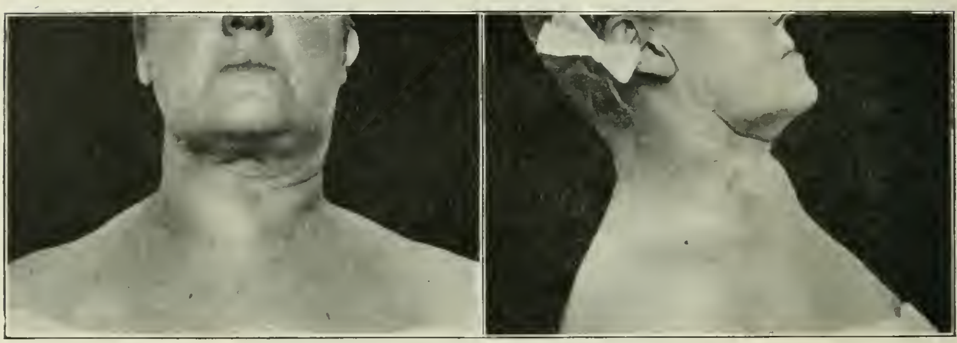

Fig. 29, *a* and *b*.—No. 893. (*a*) Solid unilateral, mainly intrathoracic, goitre, the upper part of which rises into neck. Female, aged 65. (*b*) Side view. Removed by resection-enucleation on account of dyspnœa and œdema of the arm. Note the distension of the veins of the neck.

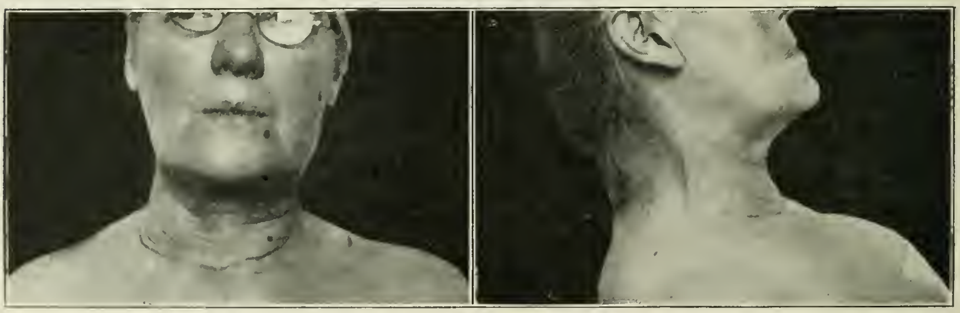

Fig. 30, *a* and *b*.—No. 893. The same patient as in fig. 29 three months after operation.

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[1] The term retrosternal or substernal goitre is also applied by many authors to goitres situated still lower down, behind the manubrium or body of the sternum; for these I prefer the term intrathoracic.

[2] It is quite common for the tip of one or both inferior horns of a goitre to descend for a short distance into the thorax, but without causing pressure in this region—such cases are, of course, not included among the intrathoracic goitres.

in elderly people, most intrathoracic goitres have undergone a good deal of secondary degeneration, fibrosis, calcification, &c., which is in one respect a fortunate circumstance, as it enables the exact shape and position to be more clearly shown by radiography. In only two of the twenty-two patients of this series was the age below 30, while the average age, as will be seen from the table, was much higher. Two patients were over 70. The large proportion of men (eight out of twenty-two) is noticeable, as is also the fact that no less than seventeen out of twenty-two occurred in private practice. The last point is difficult to explain, unless it be that many of these patients came from distant parts of England (or even from abroad) for operation, and that hospital patients are perhaps more likely to be treated in hospitals nearer their own homes.

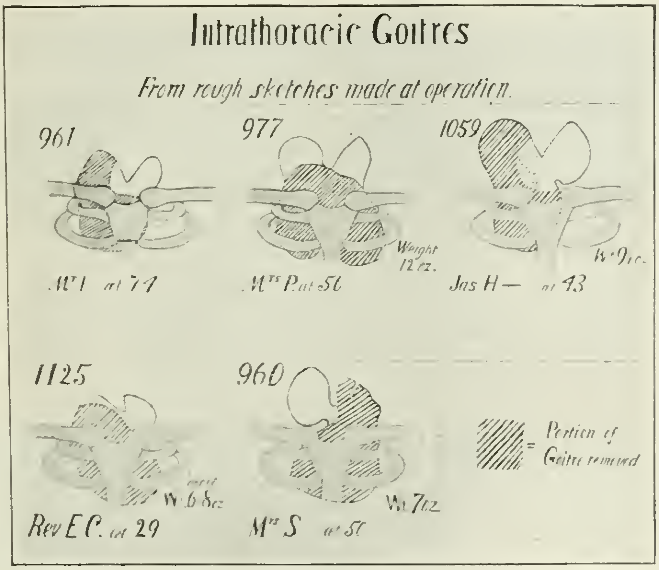

FIG. 31.—Intrathoracic tumours of various kinds. From rough semidiagrammatic sketches made by author immediately after the operations.

Intrathoracic goitres are usually attended with very severe symptoms, both respiratory and cardiac, but especially the former. But if situated entirely within the thorax and well below the first ribs, they will sometimes produce very few symptoms until they suddenly or gradually enlarge and produce severe pressure symptoms.

A very common history is that the patient has had a goitre for years, and that as the goitre became apparently smaller (i.e., became sucked down into the thorax) the dyspnœa (often diagnosed as "asthma") became worse. It is not uncommon for one side of a bilateral goitre to form an obvious tumour in the neck, while, on the opposite side, lying wholly unsuspected in the thorax, is an intrathoracic goitre which is the real cause of the dyspnœa. A case of this kind has already been cited in Section (IV).

Intrathoracic goitres, unless parenchymatous in young people (which are very unusual), are but rarely amenable to any kind of treatment short of

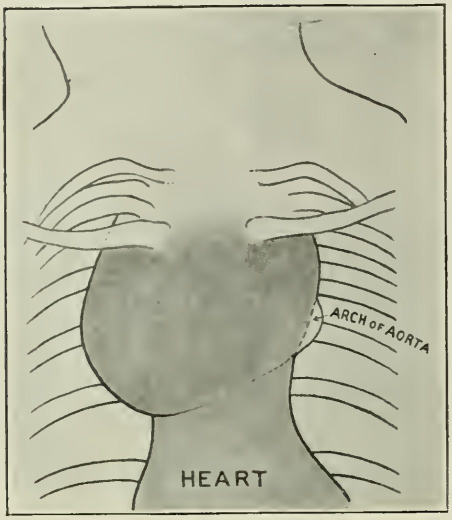

FIG. 32.—No. 779. Semidiagrammatic representation of a double but mainly right-sided, solid intrathoracic goitre, removed in 1913 by extirpation from a lady, aged 64, for dyspnœa. Weight 11½ oz. Taken two days before operation.

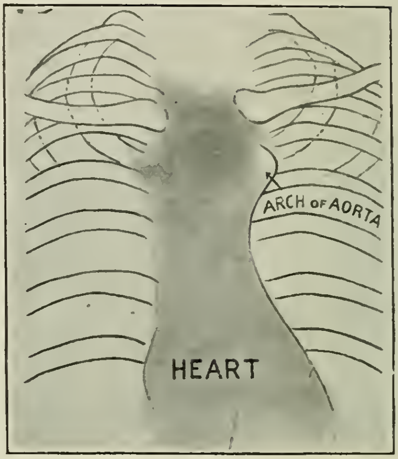

FIG. 33.—No. 779. Semidiagrammatic representation of the preceding three months later, from a tracing of the skiagram, omitting irrelevant details.

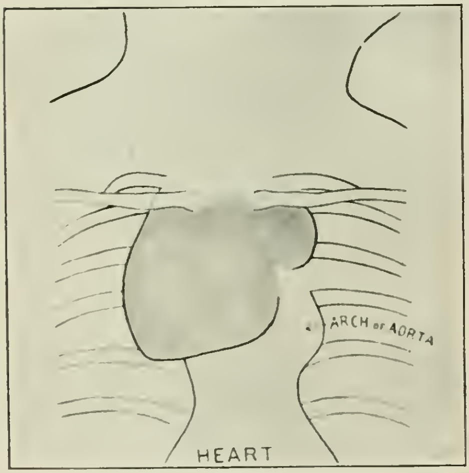

FIG. 34.—No. 1329. Semidiagrammatic representation of a bilateral, mainly right-sided, wholly intrathoracic goitre, removed by extirpation for severe paroxysmal dyspnœa. Taken shortly before operation.

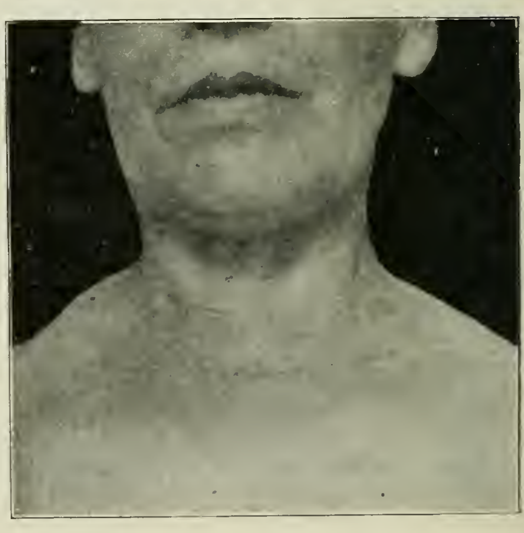

FIG. 35.—The same patient a fortnight later, showing scar of low transverse incision through which tumour was removed.

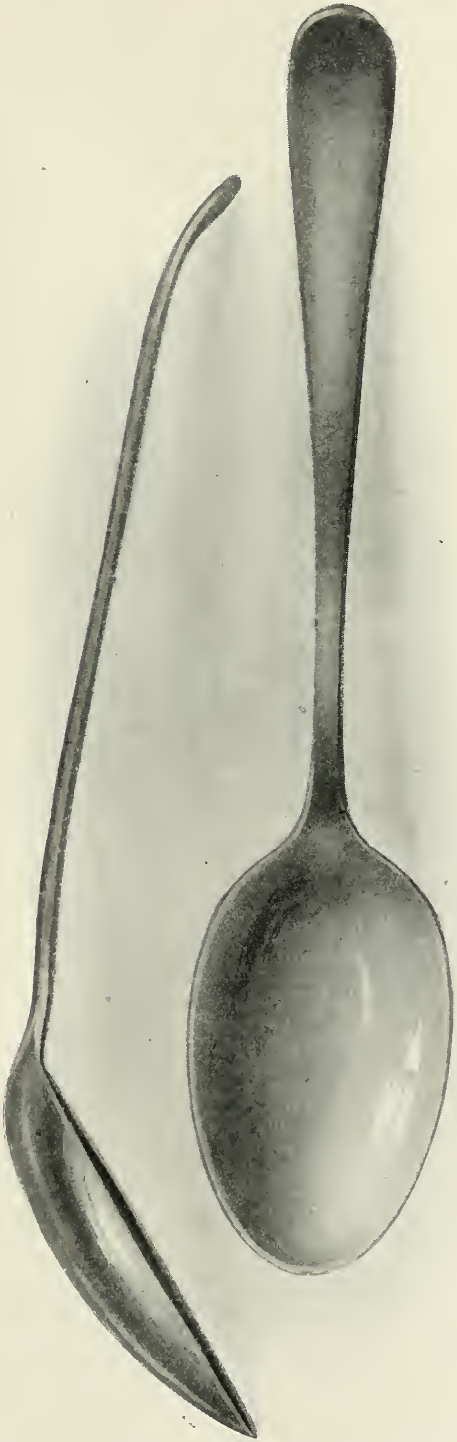

FIG. 36.—The form of silver spoon used by the author in removing introthoracic goitre. Full size.

direct removal by operation. Fortunately, in the great majority of cases these goitres can be removed by a well-executed, although naturally a somewhat serious and difficult, operation. The patients, who have usually suffered extremely from dyspnœa, and whose lives have probably been in great danger from it, are usually only too willing to submit to an operation which offers them a good prospect of complete cure. These operations are among the most satisfactory goitre operations that I have to do.[1]

The operation depends for its feasibility and success upon attention to the following points: (1) As the goitre grows downwards into the thorax it carries its main vessels with it; consequently none enter it from below upwards. If this were not so, the operation would be impossible. (2) Most of the main veins lie in front of the goitre, and no attempt should be made to extract it until these have been carefully clamped or tied. Frequently it is desirable to free the upper part of the lobe, if this is in the neck, by isolating and tying vessels in the usual manner. When these vessels have all been secured, and the top of the tumour itself has been freely bared, but not till then, the extraction may be attempted. No attempt should be made to pass any instrument down into the chest *in front* of the tumour. But at the back a space will always be found through which it is possible to pass a scoop, or better still an ordinary silver dessert-spoon or table-spoon, into the chest, behind and below the goitre. The spoon must have a rounded, not a pointed, lower edge, lest it should leave the surface of the goitre and perforate some adjacent structure such as the pleura, an accident which, however, I have never actually seen. The rounded bowl of the spoon pushes the pleura away from the goitre and facilitates its separation. Fig. 36 shows the pattern of spoon that I commonly employ.[2] The position of the recurrent laryngeal nerve must be borne in mind. The spoon must be inserted between this and the goitre. Damage to the nerve is one of the main dangers of the operation, and I have not always been able to avoid it (*see* No. 779, fig. 32).

If the goitre is old and tough, and has a well-marked capsule, several pairs of forceps may be placed upon the front of it and traction made together with a scooping movement of the spoon. If the tumour is partly cystic, so much the better, as the size may be considerably diminished by letting out some or all of the fluid.

If solid and too large to be extracted whole through the upper opening of the thorax, I have sometimes broken up the interior to reduce the size; but this is a somewhat dangerous proceeding, and, if attempted, care must be taken to keep away from the periphery of the tumour where most of the veins lie.

If the goitre is unequally bilateral, the smaller part should always be removed first, to relieve the breathing and to give more room for the extraction of the larger tumour.

The most dangerous moment of the operation is when the tumour is being delivered through the narrow upper opening of the thorax, since it is just at this time that most pressure is exerted upon the already narrowed trachea. As soon as the goitre has been delivered, a long piece of gauze is lightly packed into the thorax so as to fill up the cavity and check any oozing from its walls, and to minimize the risk of infiltration of blood into the surrounding tissues.

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[1] In the present series there were no deaths. In the preceding series (published 1913, *loc. cit.*), there was one death among eighteen cases. The patient, the skiagram of whose thorax before and after operation was published in 1913 (*Trans. Med. Soc.*, xxxvi, p. 197), still enjoys robust health at the age of 70, eight years after the operation.

[2] The use of a spoon I learnt, many years ago, from my friend Dr. Charles Mayo.

Patients with intrathoracic goitre often have attacks of paroxysmal suffocative dyspnœa alternating with periods of comparative freedom from dyspnœa. If the patient has an ordinary cold the symptoms are likely to be worse, probably from temporary swelling due to increase of fluid in the tumour. If possible, a period of intermission, when the breathing is least troubled, should be chosen for operative interference.

(VII) ANÆSTHESIA.

TABLE VII.

Year	Operations for removal	General	Local	General and local
1913	119	106	12 (11 for exophthalmic goitre)	1 (1 for exophthalmic goitre)
1914	136	116	11 (3 ,, ,,)	9 (8 ,, ,,)
1915	—	—	—	—
1916	59	59	—	—
1917	—	—	—	—
1918	75	73	2 (1 for exophthalmic goitre)	—
1919	111	108	2 (1 ,, ,,)	1 (1 for exophthalmic goitre)
Totals	500	462	27 (16 ,, ,,)	11 (10 ,, ,,)

Mere ligations of thyroid arteries for exophthalmic goitre have not been included in this paper; for many of these operations local anæsthesia was employed. There were no deaths in connexion with any of these operations.

No anæsthetic fatality occurred in any case, either of removal or of ligation.

Having quite recently discussed at some length[1] the subject of anæsthesia for goitre operations, it is unnecessary here to do more than recapitulate briefly my present views on this subject. Chloroform is never employed now in any of my goitre operations. For general anæsthesia ether is administered by the open drop method on a mask of gauze. Deep anæsthesia is never permitted at any stage of the operation, as in many cases it would be highly dangerous, especially in the earlier stages. The patient should be just sufficiently under the influence of the anæsthetic to avoid pain. In a few cases of a high degree of dyspnœa, local anæsthesia is preferable, especially if the services of an anæsthetist of large experience in this class of operation is not available. In a good many cases of exophthalmic goitre also local anæsthesia is preferable. But in both these classes of case I am using light general anæsthesia more and more, in preference to local, which is often very distressing to the patient. In some cases local anæsthesia is used at the beginning, and light general anæsthesia in the later stages, of the operation.

Of intratracheal anæsthesia, which is much praised by some, I have no personal experience. It can doubtless be employed with safety in a large number of ordinary goitre operations. But in just those cases in which it would at first sight seem to be useful, I hesitate to employ it, on account of its danger. I have heard of several cases where death occurred during or shortly after its employment for goitre operations, or in which death has occurred during the attempt to employ the method. The necessity of anæsthetizing the patient in the ordinary way before the intratracheal tube can be introduced, the necessary hyperextension of the head, and the occasional failure to get the tube past the point of obstruction in the trachea, are all serious objections which have been well pointed out by Crotti in his recent excellent book on thyroid surgery.[1] To these I would add that, in the case of a trachea already partly narrowed, the addition of even a very little inflammàtory swelling set up by the mechanical irritation of the tube, however soft, might readily increase the post-operation risks. Crotti, an operator of large experience in goitre surgery, remarks that the method of "intratracheal insufflation anæsthesia in thyroid surgery seemed at first to be full of promise. I have, however, found it disappointing. Just in the cases where it was expected to be the most useful, namely, in goitres with pressure symptoms, it failed to fulfil its expectations." He mentions no less than three cases in his own practice in which, when sudden unexpected dyspnœa occurred, he failed to introduce the tube into the trachea. In ordinary cases without much tracheal stenosis, it seems to me to possess no great advantage over simpler methods; and certainly patients sometimes complain much of laryngeal discomfort after its employment, although possibly this is less when the anæsthetist is highly skilled in the technical details of the method.

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[1] Discussion on "Anæsthesia in Operations on the Thyroid Gland," opened by Dr. May Dickinson Berry, *Proc. Roy. Soc. Med.*, 1920, xiii (Sect. Anæsth.), p. 52.

(VIII) DRAINAGE.

This has been employed in all but seven of the 500 cases; these seven were all small, short, and easy operations. After all large goitre operations there is a good deal of blood-stained serous discharge, often mixed with colloid, especially in cases of parenchymatous goitre where a considerable surface of wounded gland has been exposed; it is better that this should pass out into the dressing rather than accumulate in the wound or pass into the surrounding tissues, and thus possibly hinder the smooth healing of the deeper parts of the wound. The drainage tube is always of glass and quite short, reaching to just below the plane of the infrahyoid muscles. A longer tube is apt to cause irritation and discomfort. The drainage tube is nearly always removed on the day following that of the operation.

The space beneath the large flap of skin and platysma is not drained, but in many of the more recent cases in the series half an inch at each end of a long skin incision has been left unsutured, to facilitate the escape of any fluid which might otherwise collect under this flap. The flexed position in which the head is kept for a day or two after the operation obviates the necessity for suture at these two points.

(IX) HEALING OF WOUNDS.

TABLE VIII.

Primary union	442
Primary union except in track of drain; healing in few days to few weeks ...	34
Apparent primary union; mild suppuration after leaving hospital or home* ...	6
Secondary union after gauze drain or pack	8
Persistent small sinus; healing three to six months	3
	493

* All healed except one malignant case.

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[1] "Thyroid and Thymus," 1918. Philadelphia and New York: Lea and Febiger.

It will be seen from the above table that in the great majority of cases the wounds healed smoothly *per primam* without any trouble at all. Of the thirty-four cases in which primary union occurred everywhere except in the track of the drain, some were cases in which some accumulation of blood-stained serum took place either in the deeper parts of the wound or, much more often, beneath the skin flap. In such cases the prompt insertion of a closed pair of forceps for an inch or two into the wound is sufficient to let out the fluid, and no further trouble ensues. Occasionally the track of the drain is mildly infected, presumably from the skin surface or from some fault in the technique: none of these cases were seriously infected.

The eight cases of secondary union were mostly those in which the occurrence of a subcutaneous hæmatoma necessitated partial reopening of the wound and superficial packing with gauze for a few days.

One (No. 776) was that of a girl from whom one lobe (as large as a goose's egg) of a parenchymatous goitre had been removed on account of dyspnœa: recurrent hæmorrhage occurred three hours after the operation; the whole wound was promptly opened up; a small bleeding vein was ligated and the wound lightly packed with gauze for a few days; the patient made a good recovery without any further trouble, and left the hospital on the twenty-first day after the operation.

Details of another case follow:—

This was a very remarkable case, that of a lady, aged 60, from whom I had, in 1896,[1] removed the right and most of the left lobe of a deeply seated partly substernal, parenchymatous goitre, for dyspnœa. The parts removed weighed 11¾ oz. The operation was a very severe one, and was followed by mild suppuration and a sinus which did not heal for eight months, but she made a good although slow recovery, and remained quite well for many years. The remainder of the left lobe, however, had been gradually enlarging, and eventually caused such severe suffocative attacks that she came back to me for further operation. In July, 1914, eighteen years after the first operation, I removed a mass as large as her fist from behind the sternum and left clavicle. The operation, which was performed under local anæsthesia, was long and difficult owing to the existence of numerous old adhesions; the large cavity with unusually rigid walls had to be plugged with gauze, on account of deep-seated venous hæmorrhage from some vessel in the neighbourhood of the left innominate. She was apparently making a satisfactory recovery, when quite suddenly, twenty-eight hours after the operation, she became completely unconscious, with stertorous breathing and paralysis of all her limbs. It was thought at first that she was dying of cerebral hæmorrhage or an extensive sudden thrombosis. Her pupils were not contracted, and there was no evidence that she had taken any drug. Dr. J. A. Ormerod, of the National Hospital for the Paralysed, saw her with me, and was unable to arrive at any definite diagnosis, but thought, as I and others did, that she was not likely to recover. However, after remaining unconscious for three days, she began to recover rapidly, and in less than a month lost all traces of her paralysis. The wound remained clean and healed very slowly by granulation in the course of about four or five months. She made an excellent and complete recovery, and for the last five years, during which I have frequently seen her, she has been in excellent health, full of energy, and leading an active busy life, in spite of her age. I am quite unable to give any explanation of the nature of this curious complication. The rapid and complete disappearance of all trace of paralysis makes it scarcely possible that there can have been a cerebral hæmorrhage, as was at first thought probable. I have never seen anything like it after any thyroid operation, and it is the only serious non-fatal complication that has occurred after any operation of this series.

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[1] Case 41 published and figured (figs. 119 and 120) in my book on "Diseases of the Thyroid Gland," 1901, at present out of print.

(X) DEATHS FROM OPERATION.

Table IX gives brief notes of all the cases that have died as the result, either direct or indirect, of the operation.

Simple Goitre.—No. 757 was a schoolmistress sent to me in 1913 by Dr. W. J. Durant, of Gateshead. In March, 1898, I had removed from her left thyroid lobe an encapsuled adenoma as large as a duck's egg on account of dyspnœa (No. 54). In the intervening fourteen years she had remained perfectly well, but the remaining lobe had recently been enlarging considerably, and an entirely new train of symptoms had supervened within the last year, namely, nervousness, tremor, palpitation, rapidity of pulse, which was persistently at or above 120, and, most important of all, emaciation and glycosuria. She complained of much discomfort and some dyspnœa, and was very anxious for further operation. It was thought to be a case of secondary Graves' disease. On account of the glycosuria, for which Dr. (now Sir) Archibald Garrod kindly saw her with me, she was kept in the nursing home for more than a fortnight, and I then did a resection-extirpation of most of the right lobe, which contained a well-encapsuled adenoma of the common colloid type with commencing cystic degeneration, and weighing 4½ oz. Microscopically the gland showed none of the changes of Graves' disease. After the operation, she soon developed a low form of pneumonia, and of this she died on the twenty-fourth day after the operation. The post-mortem, which was performed by Dr. C. S. de Segundo, who had been attending the patient with me for the pneumonia, showed solidification of one lung, but the mediastinum and root of the neck were quite free from any sign of sepsis, and the wound had healed. The sputum had been examined on two occasions with the following result. "*Films*: A small Gram-negative bacillus, resembling Pfeiffer's bacillus, is present in very large numbers; tubercle bacilli not found. *Culture* (blood agar plates): Influenza bacillus in great majority; pneumococcus also present, with a few colonies of a staphylococcus."

The case appears to have been one of an infection of an old adenoma simulating Graves' disease, as such cases sometimes do, and it would have been much better had I declined to operate upon her. But at that time my personal experience of operations for Graves' disease was comparatively small, and I hoped that an operation would have benefited her.

The only other case in this series in which I have knowingly operated upon a goitre patient with glycosuria occurred ten months later, when I was obliged on account of dyspnœa to operate upon a lady, aged 52, although I did so reluctantly. She had been the subject of diabetes for a considerable time, but treatment (by Dr. Risien Russell) had kept the glycosuria fairly well under control. The goitre was an adenoparenchymatous one causing much tracheal pressure. After a week of strict dieting in the home under Dr. Russell, resection-extirpation of the left lobe of the goitre was performed. This case ran a perfectly normal course, and the wound healed by primary union without any trouble, the patient returning home within three weeks of the operation, completely relieved of all her symptoms except the glycosuria. For nearly four years she remained quite well, although still under treatment for diabetes, and I had the opportunity of seeing her on several occasions. Eventually, while on a visit to Scotland, she suddenly developed diabetic coma, and died in less than a fortnight.

No. 925 was a hospital case, a married woman, aged 41, in an early stage of pregnancy, sent to me by Dr. Falkner, of Fulham. For many years she had had a large bilateral adenoparenchymatous goitre which in a previous pregnancy, terminating in miscarriage, had caused much trouble. Her temperature was 100° F. and her pulse 110-112 before operation. As she had considerable dyspnœa, it was thought best to operate upon her at once rather than to wait many months until the end of the pregnancy, during which the dyspnœa would have got much worse. The operation, which involved removal of 10½ oz. from the right lobe and a small portion of the left, was a straightforward one. She got up, as usual, on the day after the operation, and for six days appeared to be doing well. Her temperature then began to rise. The wound was partially re-opened in the middle, some sepsis having occurred. Symptoms

TABLE IX.—DEATHS FROM OPERATION.

Case number	Date of operation	Private or hospital	Name	Age	Nature of goitre and operation	Weight of goitre removed	Before operation	After operation
					Simple Goitre.			
757	January 30, 1913	Private	Miss K. P.	40	Recurrent solid adenoma; resection-extirpation right lobe	4½ oz.	*Glycosuria*; pulse 120 to 140; emaciation	Death from double pneumonia twenty-four days after operation; no suppuration
925	May 11, 1914	Hospital	Isobel R.	41	Adenoparenchymatous, right and left	11¾ oz.	Dyspnœa; pregnant; temperature 100° F.; pulse 112	Sixth day, suppuration; tenth day, death from pleuro-pneumonia
					Exophthalmic.			
843	October 20, 1913	Hospital	James S.	50	Solid exophthalmic goitre; extirpation right and middle; local anæsthesia, with a little general	9¼ oz.	Dyspnœa; emaciation; pulse 120 to 124	Recurrent hæmorrhage from very small vein; death from cardiac failure three hours after operation
1076	March 4, 1918	,,	Bessie M.	31	Solid exophthalmic goitre; extirpation right; general anæsthesia	4 oz.	Dyspnœa; restlessness; pulse 120 to 140	Death from cardiac failure twenty-one hours after operation
1103	June 17, 1918	,,	Lottie B.	37	Solid exophthalmic goitre; extirpation right (relapse after two previous ligations by another surgeon two years previously); local anæsthesia	4½ oz.	Mitral regurgitation	Death from cardiac failure eleven hours after operation
					Malignant and Papilliferous.			
1018	July 21, 1916	Private	Miss J.	54	Recurrent papilliferous carcinoma; extirpation right with resection of common carotid artery and internal jugular vein	14 oz.	Four previous operations on same tumour in eleven years	Died soon after operation
1086	April 30, 1918	Hospital	Eliz. N.	50	Bilateral adenoparenchymatous and intrathoracic malignant mass	—	Extreme dyspnœa; cyanosis	Died immediately after operation

of pleuropneumonia set in, and of this she died four days later. The patient did not miscarry.

This is the only case of the whole series in which any serious suppurative complication occurred.

Exophthalmic Goitre.—The three exophthalmic cases may be taken together. All were bad cases. In two of them there was more loss of blood than usual during the operation. In the other case (No. 843), that of an elderly man, the operation itself, although a very severe one, was not attended with any unusual difficulty. Unfortunately a very small vein which had escaped notice at the time of the operation continued to ooze after the patient returned to the ward. The wound had to be reopened. The bleeding vein was promptly found and tied after only an ounce or two of blood had been lost, but nevertheless he died soon afterwards. All three patients died of sudden heart failure within a few hours of the operation. It will also be noticed that in two out of the three cases the operation was performed wholly or mainly under local anæsthesia. This may be noted by those who consider that the use of local anæsthesia is the main factor of success in operations for exophthalmic goitre.

Malignant and Papilliferous.—No. 1048 was the last of five operations for papilliferous carcinoma. As the long history is characteristic of this class of tumour, it may be given in some detail.

This lady, then aged 43, first consulted me in December, 1905, for a right-sided thyroid tumour which had been present for twenty years but had grown considerably in the last four or five years. In January, 1906, I removed the tumour, which was soft, solid, encapsuled, and as large as a goose's egg. It was thought to be an ordinary adenoma. It recurred and was again removed in 1908 and 1912, the tumours being soft, papillary, and very vascular. On the last of these occasions, definite microscopic evidence of its carcinomatous nature was for the first time obtained (by Dr. Ernest H. Shaw). The tumour at this operation was as large as a man's fist. The fourth operation was in 1913 for a recurrent tumour as large as a hen's egg. In 1915 it had again recurred, but, owing to my absence from England on war service, I had no opportunity of seeing her again until 1916, by which time it had attained formidable dimensions, occupying most of the right side of the neck. Had it been an ordinary carcinoma, I should not have attempted its removal; but knowing its history and papilliferous nature, and having successfully removed a very much larger one of similar nature from a much older patient in 1908,[1] I hoped I could again make a satisfactory removal in this case also.[2]

The tumour was not attached to the trachea and was cleared without much difficulty above, below, and on either side. But at the back, when it was much too late to abandon the operation, it was found that the main carotid vessels were hopelessly incorporated in the tumour and had to be extensively resected. The tumour after removal weighed 14 oz., and was carcinomatous throughout. Some glands were also involved.

No. 1086 was a case of erroneous diagnosis: it was really a case of intrathoracic malignant disease unconnected with the thyroid, and the goitre operation had little or nothing to do with the death.

The woman had been sent up from a village in Lincolnshire suffering from extreme dyspnœa and with a history of an old goitre which had become much worse lately. When admitted she was livid, sweating, and apparently dying of suffocation. She had a deep-seated bilateral parenchymatous goitre of considerable size low down in the neck: the patient was operated upon as soon as possible under local anæsthesia, becoming completely unconscious soon after the operation had begun. The lower portion of each half of the goitre was rapidly removed without any special difficulty. No relief whatever being afforded, tracheotomy was performed and a long tube inserted, with equally little benefit. Far down in the mediastinum, near the bifurcation of the trachea, a hard irregular mass of growth, evidently malignant, could be felt with the finger. It was obvious then that this intrathoracic growth was the main cause of the trouble, and not the goitre. Unfortunately no post-mortem examination was permitted, and the exact nature of the growth must remain in doubt. Had the patient been able to give a better account of her previous history, or had a more thorough examination of the chest been made, and especially if an X-ray photograph could have been taken, no operation would have been done.

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[1] Case published and figured in Lettsomian Lectures, *Med. Soc. Trans.*, xxxvi, p. 198.

[2] It is but fair to her doctor (Dr. Collard, F.R.C.S., of Croydon), to say that he believed the tumour to be irremovable, and the sequel proved him to be right.

(XI) LATE RESULTS OF OPERATIONS.

All goitre patients are asked to report themselves in person or by letter one year after the operation, and most of them do so. Many have been seen yearly. But in the last seven months an attempt has been made to ascertain definitely the present condition of each patient, and Table X shows the source of the information thus obtained.[1] I take this opportunity of thanking all the doctors and others who have been good enough to write to me.

In thirty cases, including of course the few that died, the latest information dates from some period before 1920, and in fourteen I have been unable to trace the patients after they had left the hospital or nursing home. These last fourteen were all quite well when last seen, and I have no reason to suppose that they are not all quite well at the present time.

TABLE X.—SOURCES OF INFORMATION OF LATE RESULTS.

Traced in 1920 (May to December):—		
By personal observation	109	
,, letters from doctors	191	
,, ,, ,, patients	130	
,, ,, ,, relations, friends, &c.	26	
		456
Traced before 1920:—		
By personal observation	13	
,, letters from doctors	11	
,, ,, ,, patients	2	
,, ,, ,, relations, &c.	4	
		30
Untraced since leaving hospital or nursing home (all primary union)		14
Total		500

The most important table of this paper is Table XI (*see* next page), which gives a full summary of the information obtained as above described. This table explains itself and requires but little additional comment under the three main heads.

Simple Goitre.—It will be seen that, with but few exceptions, all the patients are well. Most of them have not only been relieved completely of all the trouble from which they suffered before the operation, but enjoy much better health than formerly. I have a large bundle of letters from patients expressing the utmost gratitude for the benefit they have derived from the operation. The following is a representative selection:—

No. 771. A woman, seven years after the removal of a cystic adenoma at the age of 23, on account of dyspnœa, writes: "I have never felt so well as I have done in the last seven years."

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[1] A large number of those from whom I received information by letter were also subsequently seen and examined by myself.

TABLE XI.—LATE RESULTS.

Simple Goitre (Operations, 408; Patients, 406).		
Quite well		342
Quite well after subsequent operation on thyroid elsewhere		3
Not well after subsequent operation on thyroid elsewhere		1
Well as regards goitre, but since undergone other major operations (amputation of breast, hysterectomy, &c.)		3
Well as regards goitre, but with other symptoms, mostly minor:—		
Become very stout	2	
Stomach troubles	4	
Uterine ,,	2	
Nervous ,,	2	
Cardiac ,,	5	
		15
Well until occurrence of other fatal illness or injury unconnected with thyroid operation (*see* Table XII, p. 136)	9	
Spasmodic asthma until occurrence of other fatal illness or injury unconnected with thyroid operation (*see* Table XII)	1	
Condition unknown until occurrence of other fatal illness or injury unconnected with thyroid operation (*see* Table XII)	2	
		12
Well, but with enlargement of opposite lobe; causing trouble	5	
Well, but with enlargement of opposite lobe; not causing trouble	4*	
		9
Well, but with local troubles:—		
Paralysis of vocal cord subsequent to operation	3†	
"Dragging sensation in throat"	2	
		5
Died of operation		2
Untraced since leaving home or hospital (well and wounds healed then)		14
		406
Exophthalmic Goitre (Operations, 79; Patients, 78).		
Practically well	53‡	
Much improved	18‡	
Improved	1	
No improvement	2	
Worse	1	
Died of operation	3	
Untraced	0	
		78
Malignant and Papilliferous Goitre (Operations, 13; Patients, 12).		
Living and quite well (after years: 7½, 2¼, 2, 1⅓, 2)	5	
Fairly well with recurrence (after 1½ years)	1	
Died subsequently of recurrence (after years: 1, ⅔, ⅔, ¼)	4	
Died of operation	2	
		12
		496
Add those operated upon twice		4
	Total	500

* Probably many more not recorded. † Possibly some others not recorded.

‡ Two died subsequently of other causes.

No. 777. Another woman, seven years after operation at the age of 46, for dyspnœa and palpitation, writes: "My general health has never been better in every way than since I had the operation for goitre. I am quite well at the present time."

No. 827. A district nurse, seven years after removal, at the age of 49, of 8 oz. of goitre, for dyspnœa and palpitation, writes: "I have never had a day's illness since I left the hospital. I have been working hard ever since. I never get palpitation, and I can walk for miles without the least exhaustion."

No. 838. A gentleman, seven years after removal for dyspnœa, at the age of 67, of a 5-oz., much calcified, adenoparenchymatous goitre, writes: "Before the operation, life was really not worth living; now it is a pleasure to live."

No. 911. A lady, six years after bilateral resection-enucleation, at the age of 42, of an adenoparenchymatous goitre, for dyspnœa, writes: "I have not had the slightest

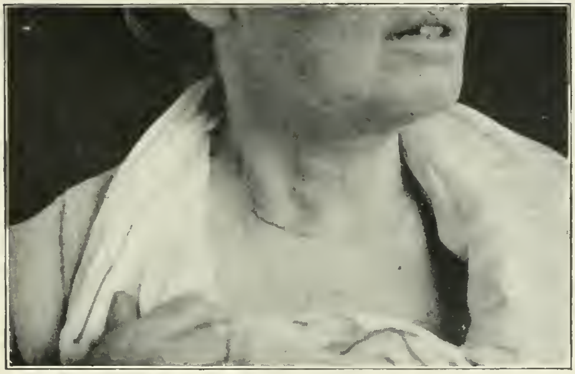

FIG. 37.—No. 760. Recent scar, showing the usual low collar incision, in a position where the scar can easily be hidden by a necklace. Female, aged 47, after removal of a solid adenoma of the right lobe weighing 6 oz. (Scar shown is too thick, but has been chosen because it shows up better in the photograph.)

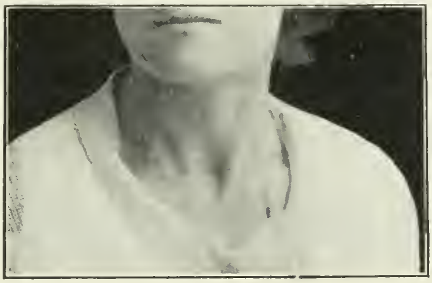

FIG. 38.—No. 1090. Similar scar two and a half years after bilateral extirpation of adenoparenchymatous goitre weighing $4\frac{3}{4}$ oz. Female, aged 29.

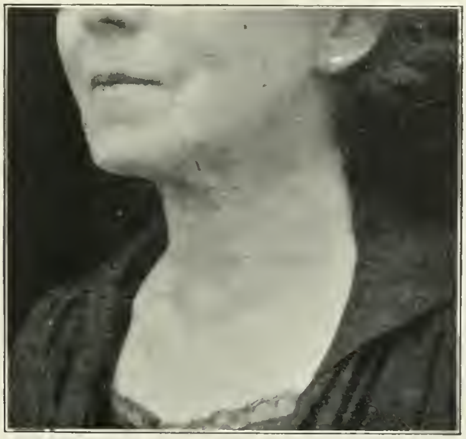

FIG. 39.—No. 1020. A similar scar four and a half years after extirpation of left lobe and isthmus. Female, aged 36.

return of the symptoms which distressed me so much before. I am infinitely better in health, and I think I am more regularly and consistently energetic than I used to be."

No. 1074. A girl, three years after a bilateral resection-extirpation, at the age of 14, of 11 oz. of parenchymatous goitre, for dyspnœa, writes: "I am in the best of health and never feel anything of my throat."

No. 1101. A lady, two and a half years after bilateral removal of an adenoparenchymatous goitre, for dyspnœa at the age of 27, writes: "I am quite well and in splendid health."

No. 1114. A gentleman, two years after bilateral resection-extirpation, at the age of 19, of 23½ oz. of parenchymatous goitre, for dyspnœa and great deformity, writes: "From the time you operated on me, I have been a new man. I have been able to take part in the most strenuous of outdoor games, a thing I was practically unable to do for a number of years previously. The effect of the operation has been wonderful, and has resulted in a complete cure, for on no occasion have I ever felt any ill effects whatsoever. Sometimes I almost forget that once I had a goitre."

No. 1133. A lady, two years after removal for dyspnœa, at the of 34, of an adenoparenchymatous goitre weighing 3½ oz., writes: "Quite well and a very different woman from what I was before the operation."

No. 1144. A woman, two years after bilateral removal, at the age of 57, for tachycardia and slight dyspnœa, of an old adenoparenchymatous goitre of 5½ oz., writes: "I am delighted to inform you what a great difference in my life the operation has made; the exhausted feeling is gone. I am gaining in weight, although leading a very busy, active life."

No. 1168. A gentleman, one and a half years after removal, at the age of 54, of an old cystic adenoma weighing 14 oz., for bulk and deformity, writes: "I am quite well; the operation has been a complete success and I have been quite a different man ever since."

No. 1169. A woman, one and a half years after a bilateral removal for dyspnœa, at the age of 40, of a goitre weighing 5½ oz., writes: "I am now feeling better than I have ever felt before. I did think at one time that I could not live long. As I could not breathe life was not worth living, but now I can breathe freely."

No. 1195. A lady, fifteen months after removal, at the age of 38, for discomfort and slight dyspnœa, of a cystic adenoma weighing 4 oz., writes: "I am wonderfully better than I used to be before my operation. I can do so many things that were quite out of the question before. For instance, I frequently bicycle fourteen miles a day, which would have been an impossible task for me before my operation last year. I can never feel thankful enough to be rid of that terrible goitre after suffering with it for so very many years. The scar on my neck has almost disappeared, and it is quite unnecessary to wear any beads or anything to hide it now."

No. 1249. A woman clerk, one year after removal of a small adenoma, at the age 45, for discomfort, depression, and slight dyspnœa, writes: "My throat is considerably relieved in every way. My general health and vitality are now better than they have been for many years, and I have lost that ever-accompanying depression entirely."

Exophthalmic Goitre.—I have found that it is very difficult to make a satisfactory classification of the results of operations for exophthalmic goitre, but I think that that shown in the table is fairly accurate. Complete and absolute cure, with no trace whatever of the previous symptoms, is comparatively rare after operations for true exophthalmic goitre. Some palpitation on exertion, or after unusual excitement, and especially some degree of exophthalmos, often a considerable amount, remain in patients who consider themselves to be otherwise quite well. Nevertheless, a large number have been changed from invalids who previously were wretched and miserable to comparatively happy beings able to do a good day's work and enjoy life.

Nearly all express themselves as being extremely grateful for the benefit they have derived from the operation. A few are no better, and some remain depressed and miserable. After a tolerably large experience of operations for this class of goitre, the following points have impressed themselves upon my mind:—

That the operation is much more dangerous than most operations for simple goitre with dyspnœa. Even when the greatest care is taken in the selection of the case that is considered suitable for operation, and in choice of operation, its extent, and the manner of its performance (all important points), disasters and failures will sometimes occur.

That many cases, when first brought to the surgeon with a view to the performance of an operation, are wholly unsuitable for any operation at that time.

That many acute cases, unsuitable for the larger operations of hemithyroidectomy, are nevertheless often capable of standing the less dangerous operation of ligation of one or both superior thyroid arteries, and often derive great benefit from this.[1]

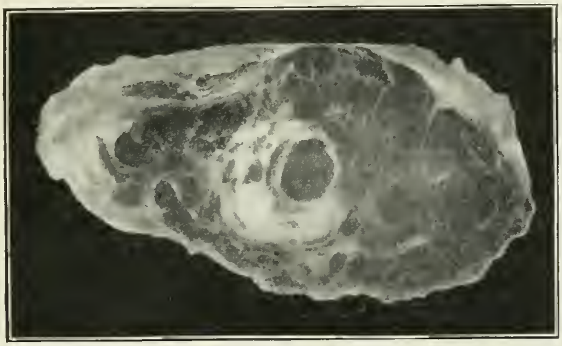

FIG. 40.—No. 1178. Spheroidal-celled carcinoma, removed with glands from female, aged 44. Secondary growth appeared on a rib nineteen months after operation. (Royal Free Hospital Museum—Ea. Rb. 425.)

That the condition of the heart, especially as regards the amount of myocardial degeneration, is a very important factor in deciding whether an operation should or should not be undertaken.

Finally, even when the operation has seemed to be most successful and the patient has appeared to be well for a long time, relapse may occur.

As, however, the medical and surgical treatment of exophthalmic goitre is to be the subject of a further communication, it is not necessary to say anything more now on this branch of thyroid surgery.

Malignant and Papilliferous.—The five patients who are still alive and well are the following:—

No. 755. A lady, aged 33, who had already undergone an operation at the hands of another surgeon for the removal of an outlying gland, underwent, seven and a half years ago, removal of the right lobe and two separate infiltrated glands in the neck for endothelioma, evidently a tumour of low degree of malignancy; she remains quite well and free from recurrence. The primary tumour was about as large as a small walnut.

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[1] With the subject of ligation of thyroid arteries, this paper, which deals only with cases of *removal* of some portion of the thyroid, is not concerned. Of removal of the thymus for exophthalmic goitre I have no personal experience.

Nos. 1129, 1146. Two male patients, aged 26 and 46, with slow-growing adeno-carcinomata, underwent extensive operations, the first involving also the removal of many glands. Both are now, two years later, in excellent health, but the first still has some infected glands, which do not trouble him, and for which he at present refuses further operation.

No. 1109. A lady, aged 47, with a large papilliferous carcinoma of eight years' duration, very similar to the case described on p. 126, is still in excellent health two and a quarter years afterwards.

No. 1140. Fig. 286. A woman, aged 65, with a small spheroidal-celled carcinoma involving one lobe only, was reported to be quite well when last heard of fifteen months after operation.[1]

(XII) COMPLICATIONS.

Recurrent Laryngeal Nerve Paralysis.—The only complication of the operation, beside those already described, is paralysis of a vocal cord, which is known to have occurred three times. This is an accident which should not occur, but is sometimes unavoidable, especially in cases of large and deep-seated tumours. One case is that of the large intrathoracic tumour described on p. 118 (figs. 32, 33).

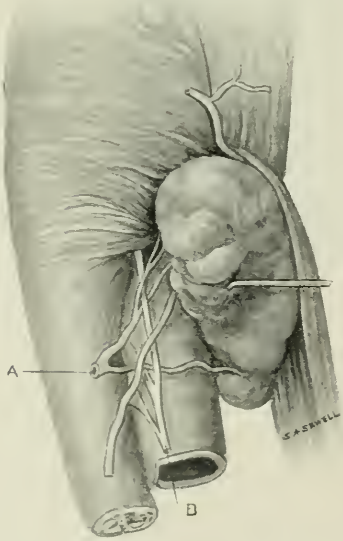

FIG. 41.—Dissection showing recurrent laryngeal nerve (B) and inferior thyroid artery (A). The thyroid gland has been drawn forward. (Dissected by Professor F. G. Parsons.)

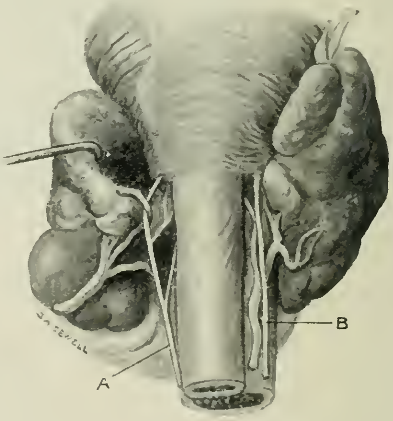

FIG. 42.—Similar dissection seen from behind. On right side the close proximity of the nerve (B) to gland is shown. The left side shows how pulling gland forwards may displace the nerve (A) and render it more liable to injury during an operation. (Dissected by Professor F. G. Parsons.)

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[1] As these sheets are passing through the press (February, 1921), further news comes from her doctor that this patient has since died, "presumably of recurrence in the thorax," twenty-two months after operation.

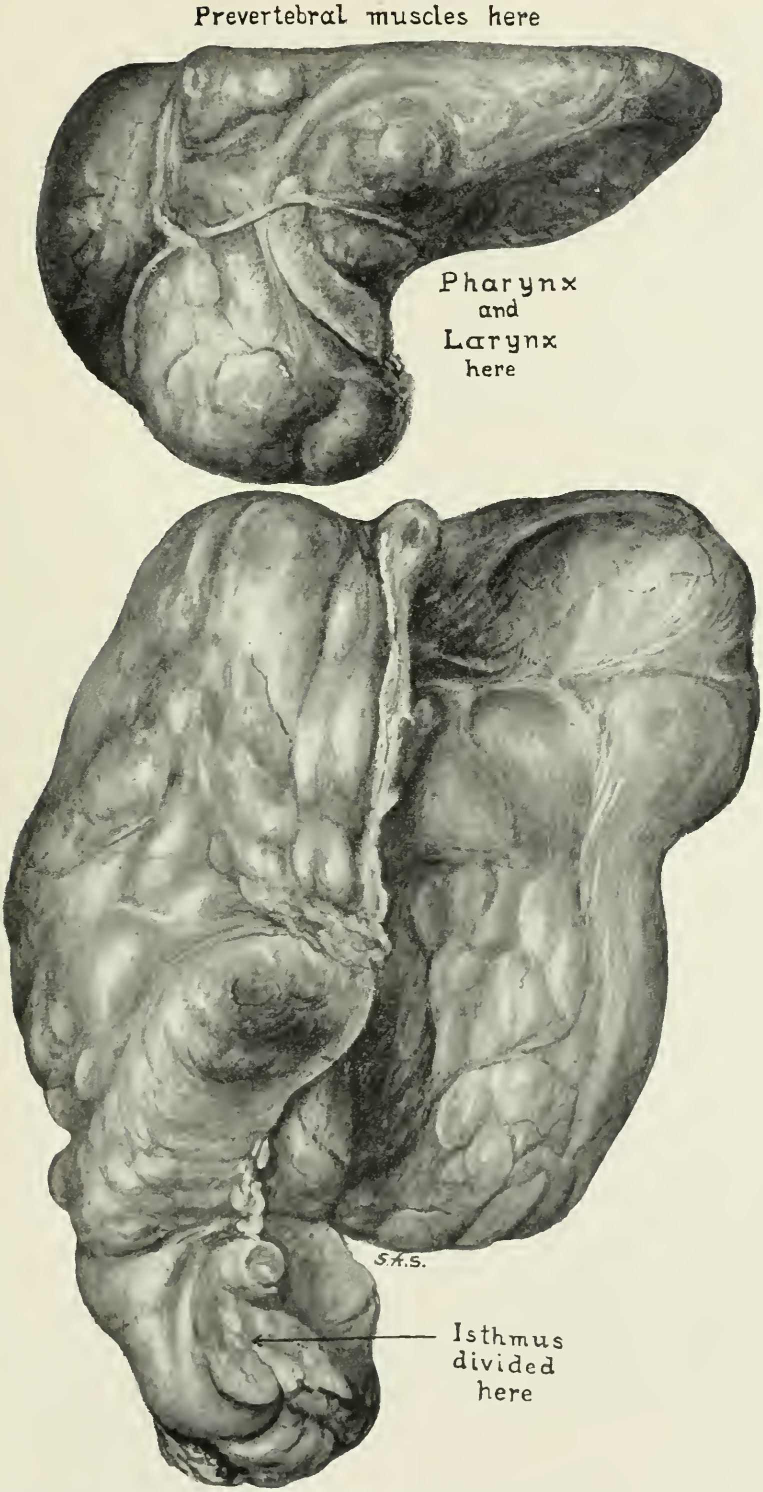

FIG. 43.—No. 1304. A solid, largely retropharyngeal right-sided goitre removed from female, aged 44. Weight 11 oz. (Natural size.)

The tumour may displace the nerve from its normal situation, and the best way of avoiding it is to be thoroughly acquainted with the situation in which it is likely to be found, and the alteration which occurs in its positions when the trachea is displaced, or when during the operation the thyroid lobe is drawn forwards, as the nerve may be drawn forwards with it. The point at which the nerve is most likely to be cut or clamped is not far below the lower border of the pharynx. It will be seen from the accompanying drawings of dissections, which have kindly been made for me by Professor F. G. Parsons, and are now in the anatomical department of St. Thomas's Hospital, that the nerve does not lie actually in the groove between the œsophagus and trachea, but a little in front of this. For the acquisition of that correct anatomical knowledge which is so essential for the proper performance of the more difficult thyroid operations, I would strongly urge the study of the dissected preparations of which such large numbers exist in most of our pathological museums, especially the older ones.

The relation of the posterior part of the gland to the pharynx is one of especial importance, since it so frequently happens that this portion of the goitre, especially in parenchymatous cases, extends round behind the pharynx as far as the middle line, or even beyond it. This backward and inward extension may be a source of considerable embarrassment to an inexperienced operator (*see* figs. 20 and 43).

Fig. 43 (1304) illustrates an unusual degree of this postpharyngeal extension, and also the fact that a vocal cord paralysed before operation by the pressure of a goitre will occasionally, although not often, recover after operation. This lady, aged 44, was sent to me by Sir StClair Thomson, mainly because of the paralysis of the right cord. She made a rapid recovery, and he tells me that the movements of the cord have now, five months later, been completely restored.

Another patient (No. 785), a professional singer, aged 52, from whom in 1913 I removed a solid adenoma weighing 6 oz., partly for dyspnœa but mainly because she was losing her voice, has completely regained it.

Thyroid Insufficiency.—With regard to the quantity of gland that should be removed in an operation for goitre, I would say that as little should be removed as will suffice to remove the symptoms for which the operation is undertaken, that the whole gland should never be removed, and that the hilus should be interfered with as little as possible; much must depend on the nature of the goitre and the extent of its degeneration. Myxœdema will then not occur. There has been no marked case of myxœdema after any of my operations, although in a few cases, chiefly of very extensive bilateral removals, the patients have suffered for a time from transient symptoms of thyroid insufficiency, and have been all the better for the administration of a little thyroid occasionally. It should not be forgotten that some goitre patients with much degenerated thyroid gland suffer already to some extent from thyroidal atrophy. With such patients, if operated upon at all, much care must be taken to remove as little as possible of secreting gland tissue.

Tetany.—Although I have, up to the present time, performed operations for the removal of goitre 1,338 times, I have never seen tetany after any of my operations, nor have I ever heard of any case of mine in which it has occurred subsequently. The exact cause of tetany after thyroid operations is still, in my opinion, obscure. The ordinary explanation that it is due to injury of the parathyriod glands seems to me to be not by any means satisfactory.

A mountain of literature has grown up round the subject of the parathyroids, and I must confess myself still an impenitent sceptic as to the supposed separate function of the parathyroids. I never take any special care to avoid them, although I usually do leave a piece of gland at the hilus for many reasons. It may be that, like the famous character in Molière's play, who had been speaking prose all his life without knowing it, I have all along been taking special precautions to preserve the parathyroids without knowing it. The practical point seems to me to be that, provided you leave a piece of gland at the hilus, you need never trouble about the parathyroids at all.

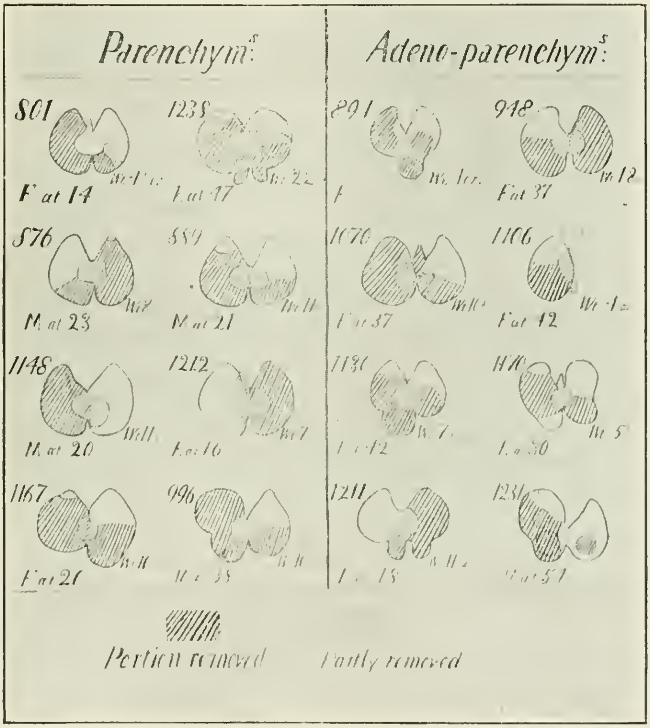

FIG. 44.—Representative diagrams of operations for parenchymatous and adeno-parenchymatous goitre, showing amount of gland removed in each case. From rough sketches made by the author immediately after operation.

Even if I wished to remove all the parathyroids, I could not be sure of doing so without performing a complete removal of the whole gland, or damaging it so much at the hilus on both sides that it would be practically useless. Besides, even if all four parathyroids could be removed, there would still remain the so-called parathyroid tissue that exists within the gland itself.

Undoubtedly tetany has often occurred after complete thyroidectomy, but this is an operation that I have never in my life performed. I have never seen any case in which I have wished to do this operation, and I doubt whether the necessity for doing it ever arises. It certainly never does in any form of innocent goitre.

(XIII) SUBSEQUENT DEATHS FROM CAUSES UNCONNECTED WITH OPERATION.

TABLE XII.

No.	Sex	Age	Cause of death	After	Intermediate condition
			Simple Goitre.		
814	M.	70	"Bronchitis and heart"	3 years	Not known
951	F.	57	"Heart dropsy"	4 ,,	"Wonderfully well"
881	F.	22	"Bright's disease"	2½ ,,	Well (married)
840	M.	37	"Some acute illness"	6 ,,	Well
864	F.	52	Diabetic coma	4 ,,	Well but diabetic
887	F.	51	Carcinoma, breast	3½ ,,	Not known
930	F.	63	Carcinoma, œsophagus	8 months	Not known
927	F.	40	Cause unknown	3-4 years	Well
889	M.	21	Killed in battle	3 ,,	Well
820	F.	43	Run over	7⅓ ,,	Well
811	F.	32	Childbirth	6 months	Well
1156	M.	26	Spasmodic asthma	1½ years	Asthmatic
			Exophthalmic.		
847	F.	40	Violence	7 months	Ill of exophthalmic goitre
851	F.	20	Acute influenza	6 years	Well
867	F.	25	Acute rheumatic fever	4 ,,	Well
1225	F.	37	Heart disease	7 months	Much improved
			Malignant.		
754	F.	40	Recurrence of carcinoma	1 year	Gradually getting worse
950	F.	50	,, ,, ,,	8 months	,, ,, ,,
1040	F.	59	,, ,, sarcoma	8 ,,	,, ,, ,,
1198	F.	54	,, ,, ,,	3 ,,	,, ,, ,,

If the after-history of any series of 500 persons, whatever be the matter with them, is traced over a long period of years, it will be found, of course, that some have died. Table XII shows, as far as any mere table can show, what I believe to be correct, namely, that none of the deaths in it are in any way attributable to the operation for goitre.

Section of Surgery.

President—Mr. Walter G. Spencer, O.B.E., M.S.

General Considerations (the Fate of Silk, Nerve Regeneration, Internal Scars) from a Surgical Backwater.[1]

By Edred M. Corner, M.Ch.Cantab.

Lord Lister demonstrated to the world how to prevent fermentation and putrefaction in the matters contained within a wound, and he maintained the proof of this in his work. Clinically, fermentation made itself apparent as suppuration. By carrying out and expanding his work his successors in surgery have reduced the incidence of suppuration in civil cases to about the level of unavoidable error. The bodily generalization of the sepsis expressed itself clinically as pyæmia and hospital gangrene, which are now almost unknown. But further work has been left for his successors to deal with on similar lines. Lister dealt with obvious suppuration. A sub-suppurative condition, a non-obvious suppuration, is now suggested. This past war, with all its gross infectivities, has made these things loom sufficiently large in the sight of more ordinary men to enable them to appreciate the importance of infections, both suppurative and sub-suppurative.

During my work in what may be termed a surgical backwater, among the amputés at the Queen Mary's Auxiliary Hospital for the Limbless, Roehampton, I had both time and material for examination. The material was supplied by the surgery of the War in the Royal College of Surgeons, St. Thomas's Hospital, the King George Hospital, &c., and the Medical Research Committee, through Sir Walter Morley Fletcher, helped to supply the means to carry out the necessary investigations. By these measures it has been possible to show here, at the Royal College of Surgeons, and on many other occasions, that in every wound infective scar tissue was present, sometimes in great amount or in masses, or else in thin layers. It was particularly in evidence where "dead spaces" existed, waiting to be filled up. The infectivity of these scars has been abundantly proved, both clinically and bacteriologically, the weak link in the chain of this proof being the demonstration of the organisms present in the tissues. In further proof of this infectivity it is merely necessary to cite the work of Dudgeon,[2] Sargent,[3] and the various communications[4] which I have made at the Royal College of Surgeons, the Harveian Society, the Royal Society of Medicine, &c. In the majority of these communications there was much more to be said than time allowed, and therefore I wish to say a portion of it again, but in another way, taking as the text alone "infective scar tissue," in surgery one of the leavings inherited from our predecessors and one of the chief difficulties which surgeons of our time have to conquer. The principles of the pathology and cure of infective scar tissue are of general application, and of use in all kinds and varieties of surgery—for what wound does not contain a "dead space" to be filled up?—whilst advances in technique in the art of surgery are but local in their application to the art. It is the universal applicability of the teaching which is the reason for the presentation of this paper to this Section on general surgery. It might well be entitled the pathology of the "dead spaces" in surgery. To surgery in art and science it is of even more general applicability than is cancer or any other disease to the human race.

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[1] At a meeting of the Section, held March 2, 1921.

[2] Dobell Lecture, *Lancet*, 1908, ii, p. 651.

[3] Sargent and Dudgeon, *Trans. Med. Soc.*, 1907, xxx, p. 27.

[4] *Proc. Roy. Soc. Med.*, 1918, xi (Occ. Lect.), p. 7; *Brit. Med. Journ.*, 1918, i, p. 665; *Journ. Roy. Army Med. Corps*, 1918, xxx, p. 486; *Practitioner*, 1920, civ, pp. 81-85; *Lancet*, 1919, i, p. 840.

Up to now there may be taken as proved :—

(1) The universal presence of scar tissue in wounds, varying greatly in amount. Let us also remember (*a*) its particular use, and therefore incidence, in the filling of all dead spaces in surgery, operative and non-operative (hæmatomata, fractures, &c.); (*b*) its possible rôle in the keeping up of irritation to bring about the union of fractures and the healing of wounds; (*c*) its possible rôle in the incidence and distribution of carcinoma, supplying the irritation which is habitually found in gross form as in phimosis and kangri; (*d*)its possible rôle in the isolation of foreign bodies, tissue changes, and foci of disease, and in the natural cure of the latter. Hence the present non-cure of cancer in being both promoted and cured by the same means; (*e*) its infective character.

(2) The dual origin of its infectivity, autogenous (home-found) and from without.

It would appear that the use of gloves, masks, and other details of surgical technique, assistants to asepsis, influence the character of this infection. Amongst the many organisms which have been isolated from scar-tissue are the *Staphylococcus albus*, the *Staphylococcus aureus*, the colon bacillus, the pneumococci, &c., with hosts of saprophytic and non-pathogenic organisms.

It may now be urged :—

(1) Its absence is a very important factor in the painlessness of healed wounds and in the healing wounds.

(2) The clinical symptom of its presence is pain and discomfort in a wound which has healed quickly, or too quickly, and often by first intention.

(3) It does not manifest its presence clinically by suppuration.

(4) It does come into evidence through the presence and persistence of a local œdema. It is apparent in local pain and tenderness, which may go, the local œdema being left behind as the only sign of its presence. The œdema, too, may disappear without the power of the scar-tissue being lost.

(5) Clinically, the work of the scar-tissue has been demonstrated in amputation stumps and, in this way therefore, its presence can be detected there.

From an amputation wound the products of repair are carried up by way of the lymphatics into all structures which have their cut ends in the scar tissue. It is important to note that the inflammatory products are carried off by the lymphatics which accompany the vascular and neural trunks, so that when these two structures are associated a neurovascular bundle is produced. Neurovascular bundles are almost always seen in the upper arm, but important bundles are also found in Hunter's canal, the popliteal space, and with the posterior tibial artery.

As time passes, this infective scar-tissue is slowly sterilized by the chemicals and living cells of the blood and lymph.

Clinically it is necessary to diagnose :—

(1) Its presence.

(2) Its activity.

(3) Its having died out and become inactive.

In dealing with amputation stumps a *skiagraph* is necessary for this purpose. In this way the presence or absence, the activity or inactivity, of the scar-tissue in the bone are demonstrated.

(1) Its presence (confirmed by tenderness and œdema of the stump) is shown in (*a*) the formation of new bone (the results of irritation); (*b*) the lengthening of the bone; (*c*) the presence of terminal opacity; (*d*) the presence of sequestra; (*e*) signs of inflammation having passed up the bone—e.g., nodes, acicular sequestra, osteomyelitis, osteitis, periostitis (indistinctness in a good skiagraph).

(2) Its activity is shown in the continued progress of the signs, with the addition of (*a*) continued murkiness of bone structure in a good skiagraph; (*b*) non-sealing of the bone end; (*c*) non-cessation of tenderness and local œdema.

(3) Its having died out and become inactive is shown by the sealing of the bone end. It would appear that the ends of large bones like the femur are more easily sealed than the ends of small bones like the fibula. Hence new bone, as in the almost universally present adductor spur on the femur, is an important sign of its presence in that bone, and sealing of bone for the cessation of its activity. In the leg the tibia may be sealed and the fibula not. The skiagraphic signs of its progress cease and the local signs disappear.

The divided bone often increases in length up to half an inch of opaque bone, mostly from the divided medulla. On the top of this is a non-opaque increase, where the muscles are reattached. This increase in length is worthy of consideration when arranging for the refitting of a difficult stump.

In the writer's personal experience this scar-tissue may so lengthen the fibula as to make it actually longer than the tibia, a fact proved by skiagraph, and by seizing on the same occasion the posterior tibial nerve giving rise to pain and disability which demand operation when the end of the bone with the posterior tibial artery and nerve are resected and the wound temporarily drained. Such cases as these may appear some years after the amputation.

In an artery it prevents the encapsulation of its ligature but breaks it up into fragments if the ligature is of silk or thread, and the particles so formed are transported, carrying and distributing the sub-suppurative infection, principally via the vascular and neural lymphatics. Hence the post-operative occurrence of aneurysms, neuritis, rheumatism, lumbago, endocarditis, &c.

The infection in this scar-tissue emphasizes the behaviour of the unabsorbable ligature and its undesirability in surgery.

With regard to nerves, first, whether the infective inflammation has got into the nerve bulb or not clinically determines whether the nerve bulb is painful or not. Or, in the words of the practical surgeon, whether the patient has "bulbous nerves" or not. Secondly, the perineuritis so induced travels higher up the outer side of the nerve than the inner—endoneuritis. An important practical observation as to its presence is shown by adhesions, and the operating surgeon, in dividing the nerve, can be sure when he is above the infection. Thirdly, the cutting of the nerve short at the amputation, and the resecting of the nerve by other than a simple method, such as by the flaps of Nicholas Senn or Sampson Handley, or by the "circumcision" of Major Chapple, are useless to stop the regeneration of the nerve but are useful to prevent the entrance of infection within the nerve trunk. Fourthly, regeneration of the nerve must not take place in tissue which has not yet been sterilized or rendered innocuous by the lymph or plasma, or pain will recur. This has often been seen when nerve trunks have been resected above an infected bulb, left behind. Subsequently the bulb is reinnervated, or neurotized, and the pain returns.

Such methods of sterilizing this infective scar tissue *in situ*, and in the living body, as heat, massage, electricity, light, exercise, tonics, are very slow. Patients become impatient and hospitalized. Treatment by vaccines, usually a shot in the dark, offers some promise of help but appears to fail clinically more often than to succeed. About 1905, Dr. L. S. Dudgeon and I read a paper at the old Clinical Society on "Post-operative Acute Diffuse Tuberculous Infection," and for prevention and cure advocated drainage. At the time this was viewed with horror as a dreadful throw-back in technique. The drainage was sure to become septic! Indeed, it invited sepsis! As a result no headway was made. For the treatment of scar tissue also I advocate drainage. Nowadays our technique is so good that drainage can be safely done for a few days and not be followed by sepsis. So that after sixteen years' surgical experience and reflection I re-advocate it for non-suppurative infections. At the same moment I would point out two things:—

(*a*) It has been practised with success in the treatment of obviously suppurative infections for years.

(*b*) Two specimens were shown with an epidiascope at my Harveian Lecture (delivered at the rooms of the Medical Society before the Harveian Society 1919) of (i) first intention union and the consequent large formation of fibrous tissue; (ii) suppuration and frank drainage with very little formation of scar (fibrous) tissue. Illustrations of these are shown to-night.

All cases exhibiting healing by first intention, or near to it, must be regarded as very likely to contain plenty of infective scar tissue and therefore be viewed with suspicion. The other treatment is reamputation and drainage, whilst that urged is the temporary and aseptic drainage of surgically clean (non-suppurative) wounds.

1 4

Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.

President of Sub-section — Mr. E. LAMING EVANS, C.B.E., F.R.C.S.

Case of Dislocation of the Hip and other Deformities.[1]

By B. WHITCHURCH HOWELL, F.R.C.S.

M. S., FEMALE, aged 7½, has never walked properly. When aged 2 she had pneumonia and then diphtheria, and after recovery she began to walk. Mother states that it was only then that she noticed the waddle and deformity of feet. Patient is seventh child; birth normal, always delicate. Fourth labour, twins. No deformities in family. Fairly intelligent.

Right lower limb: 1 in. short; talipes equino-valgus; knee contracted, range starting from 160°. Hip dislocated. Coxa valga (plates shown).

Left lower limb: Talipes calcaneo-valgus; slight wasting of leg; ? action tibialis anticus; knee contracted, range starting from 135°.

Spine: Scoliosis to right; dorsilumbar.

Gait: Great difficulty in walking; gait stiff but not spastic; no alteration in sensation.

Hands: Phalanges of digits five radially deformed.

The dislocation of right hip is regarded as congenital, while the other deformities are regarded as secondary to the pneumonia and diphtheria.

Case for Diagnosis.

By M. FITZMAURICE-KELLY, F.R.C.S.

J. H., MALE, aged 54. Injured in 1902 by fall from a horse in the Argentine. Fracture of left patella (still ununited) and injury to right knee. The joint was opened and drained in the British Hospital, Buenos Aires, four days later. Was four months in hospital, and was well enough to ride again twelve months after the accident. Joined the Army during the war and served in Royal Engineers. Was struck on knee by a balk of timber on April 17, 1919, while in Palestine. Remained on duty for a week, then went into hospital, and has been under treatment since.

When seen in early January, 1921, great swelling of right knee, which contains fluid; surrounding the joint are several firm, elastic masses, which do not communicate with it. The largest of these is in the region of the bursa in connexion with the insertion of the sartorius, gracilis, and semitendinosus. Movement is free and painless, but there is some aching of the joint after prolonged use. The skiagram shows opaque masses in the region of the swellings and of the supra-patellar pouch of synovial membrane—no bony change.

The pupils are unequal and irregular, but react normally. Knee-jerks unobtainable owing to condition of knees. Wassermann reaction negative, and no history of syphilis.

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[1] At a meeting of the Sub-section, held February 1, 1921.

Postscript.—Since the case was shown operation has been performed. The swelling over the inner tuberosity of the tibia consisted of a multilocular mass containing a little fluid resembling synovia, but chiefly a solid mass resembling altered blood-clot.

The result of microscopic examination will be communicated later.

Trigger Thumb.

By A. E. Mortimer Woolf, F.R.C.S.

Patient, a woman, aged 42, while plucking and trussing a fowl five weeks ago, felt sudden pain in interphalangeal joint of left thumb. Immediately after accident noticed that she was unable to extend this joint actively. The thumb could be straightened by pushing the distal joint backwards, and on doing so she felt and heard a sharp click. Since then the disability has remained. No history of any trouble with thumb before above-mentioned occurrence.

On examination, terminal joint of thumb is held midway between flexion and extension. She cannot voluntarily extend, but this can be done passively. A click is then felt, impulse of which is communicated up thenar eminence. When extended in this manner, flexion can only be obtained by similar means, with like result. Some thickening at metacarpo-phalangeal joint, but disability appears to be at interphalangeal joint. In other words, disability is unlike that usually associated with cases of trigger thumb.

X-ray shows very small spicule of bone on palmar surface of base of terminal phalanx.

There are two well-marked sesamoid bones at the metacarpo-phalangeal joint.

Ununited Fracture of the Middle Phalanx.

By A. E. Mortimer Woolf, F.R.C.S.

Six months ago patient, male, aged 29, hit inner side of flexor surface of left fourth finger with hammer. The terminal joint of finger became swollen and painful, but not sufficiently to cause him either to seek advice or to cease work. Finger has never become normal. Joint has always remained slightly stiff and tender.

On examination: Limitation of movement of the distal joint, but joint not stiff. Bony swelling on inner side in situation of head of intermediate phalanx; slight movement can be obtained; swelling tender.

X-ray shows an ununited fracture of head of second phalanx involving joint.

Case of Still's Disease.

By Aslett Baldwin, F.R.C.S.

The case which the President has kindly shown for me is that of a girl aged 13. There is a history of Still's disease since she was aged 5. She has had enlarged lymphatic glands and spleen; these have now subsided. The knees are flexed to a right angle with very little movement. The tibiæ are displaced back behind the condyles of the femora. The femora are flexed to a right angle at the hip joints, with little movement; they are also adducted. The spinal joints are affected, she can only partially rotate her head. There is little movement in the wrists, their position is normal. The finger joints are also involved. A radiograph shows rarefaction of the bones entering into the thenar joints.

I should be greatly obliged for any suggestions for any treatment which would ameliorate the deplorable condition of this girl.

Demonstration on the Actions and Electrical Treatment of the Intrinsic Muscles of the Foot.

By G. MURRAY LEVICK.

[DR. MURRAY LEVICK prefaced a demonstration of his method of treating the intrinsic muscles of the foot by the following remarks on the rôles of these muscles and their importance in maintaining the longitudinal and transverse arches. In demonstrating his method of treating these muscles electrically the various groups were singled out and made to contract in response to faradic stimulation, so as to show clearly the accuracy of what he had said, and the efficacy of the treatment in certain affections of the foot.]

The treatment is applicable to the preliminary stages of flat foot, and the after-treatment of those more advanced cases which have been wrenched and fixed in plaster or undergone surgical operation. The rôle played by the flexors of the toes (especially flexor brevis hallucis and flexor brevis digitorum) in supporting the longitudinal arch of the foot is a very important one, because when the weight of the body is thrown forward on to the toes with the heel off the ground the action of both long and short flexors is to draw the heel towards the toes, this acting as a bow-string across the arch from heel to toe. For this reason the way to land from a jump is to have the whole weight of the body borne between the balls of the feet and the ends of the toes. When patients are given heel-raising exercises from the standing position this distribution of the weight should be carefully taught by telling them to grasp the floor with the toes, which thus become the fixed point from which these flexors act. Flexor brevis digitorum, being inserted into the middle phalanges, is at a mechanical disadvantage in bending the toes when compared with flexor longus, and therefore acts more strongly as an arch raiser. The flexors of the toes should be used to assist progression in walking quickly or running, those of the great toe being of special importance. If these points are borne in mind the efficacy of the treatment will be clear. Graduated contraction of any of the intrinsic muscles can be obtained at will. As this treatment is carried out and the active electrode is placed in position to stimulate the desired group of muscles, a clear view is obtained of the action of the dorsal interossei in raising the transverse arch of the foot. It is seen that this is a strong action, and it emphasizes the importance of these muscles. As the core of the coil is introduced and withdrawn, the transverse arch is seen to rise and fall in time with the rise and fall of the current, and a clear mental picture can be formed of the dorsal interossei with their bipennate origins drawing the metatarsal bones together. To describe the action of one of these muscles suffices to explain the action of the rest, and for purposes of demonstration we will consider the second metatarsal bone as the keystone and as the middle line. When the second dorsal interosseous muscle contracts it performs the following rôles in the order given. These rôles have been carefully observed during electrical stimulation of individual muscles, and then of the group as a whole.

(1) Feeble contraction. Abduction of first phalanx from middle line.

(2) Stronger contraction. Flexion of metatarsal-phalangeal joint, plus the pull on the extensor tendon. End of the toe brought into contact with the ground (in voluntary movement this contact is, of course, strengthened by the flexors).

(3) Powerful contraction. The fixed points from which the muscle acts are now (*a*) the second metatarsal bone; (*b*) the insertion of the tendon into the first phalanx. As the muscle contracts the third metatarsal bone is drawn towards the second—i.e., towards the middle line. In voluntary movement the second metatarsal is fixed by the opposition of the first dorsal interosseous muscle, which also fixes the first phalanx of the second toe, and so on.

As each metatarsal bone is drawn towards the second metatarsal it is pulled into a plane below that of its more mesial neighbour. It will be seen that the arch-raising action of the dorsal interossei is very powerful, and that these muscles must be regarded as of great importance. Still more strongly is the impression given of the action of the short flexors of the toes in raising the longitudinal arch, while the toes, acting as fixed points, press the bottom of the bath. The marked action of abductor hallucis shows how it can still be trained to assist in maintaining an improved position of the great toe when this has been corrected by mechanical means. Tibialis posticus and the long toe flexors are stimulated individually, and are each seen to raise the longitudinal arch in turn.

The method of treatment shown is strongly to be recommended as a preliminary to voluntary exercise. It is a waste of time and discouraging to the patient to begin re-education before the intrinsic muscles of the foot are in at least a fair state of nutrition. I regard it as inseparable from the satisfactory treatment of flat foot after seeing the surprisingly good results it has yielded. Often it is difficult or impossible to re-develop the small muscles by voluntary exercise alone; this applies especially to those cases which have been re-postured by surgical means, so that they are suddenly relaxed after a long period of over-stretching with its accompanying atony.

Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.

President of Sub-section—Mr. E. Laming Evans, C.B.E., F.R.C.S.

DISCUSSION ON RECURRENT OR HABITUAL DISLOCATIONS.[1]

The President (Mr. E. Laming Evans)

said that before commencing to discuss the question of recurrent or habitual dislocations, it was necessary to define what was included in, and what was excluded from, such a term.

Recurrent or habitual dislocation was a condition in which a joint, after a dislocation, had been reduced and had remained reduced, offered a subnormal resistance to redislocation and, in fact, suffered repeated dislocations by slight force. If they accepted this definition, the following joints were the subjects of recurrent dislocations: (1) Shoulder, (2) temporo-maxillary, (3) femoro-patellar, (4) hip. In these joints, the articular surfaces were normally in contact; abnormally, by slight force, dislocations habitually recurred. Other cases, such as dislocations of the knee-joint in rupture of the crucial ligaments, of the acromio-clavicular and sterno-clavicular joints, in which, though reduction might have been performed, the joint had not remained reduced, were, properly, excluded by the definition. Again, cases of gross injury to the articular surfaces or to the soft parts which prevented a true reduction of the original dislocation, and in which the normal articular surfaces were not usually in contact, were excluded. Again, a case of subspinous dislocation, in which failure to maintain reduction, was due to rupture of the subscapularis, was excluded by reason of the fact that recurrence could not occur in a joint which was habitually dislocated.

The terms "recurrent dislocation" and "habitual dislocation" were accepted as synonymous because they had been handed down from traditional periods, but he thought the term "habitual redislocation" would be more accurate.

Of the habitual dislocations that of the shoulder-joint was by far the most common. This was partly accounted for by the fact that 50 per cent. of all dislocations occurred at the shoulder, partly by the methods of reduction employed by unskilled hands, partly by the defective after-treatment employed and partly by the normal anatomical structure of the joint and of the pathological lesions inflicted by the initial injury.

Habitual dislocations might be due to osseous, capsular, ligamentous, tendinous or muscular causes. Fractures of the humeral head, or of the surgical neck with subsequent faulty alignment might be present. Rupture of the capsular ligament, especially round the glenoid cavity, might lead to weak and distensible scar tissue. Ligaments might be broken and repaired in an elongated condition. Tendons might be ruptured and fail to unite to any part of the humeral neck. Rents in muscles might be repaired by distensible scar tissue. Other cases might be attended by a general lack of tonicity of ligament, tendon and muscle without gross anatomical change. It was obvious that the direction of the dislocation would determine the orientation of the peri-articular lesions.

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[1] At a meeting of the Sub-section, held March 1, 1921.

With regard to the treatment of a condition in which so many divers pathological lesions might be present, it was obvious that many methods of treatment must be employed. The prevention of recurrence by appropriate methods of reduction and after-treatment, though of paramount import, was not before the Sub-section in the present discussion. The following methods of treatment to prevent redislocation had been employed :—

(1) Palliative, by appliances of various materials and of various designs. They aimed at limiting the joint movement in all or in various directions.

(2) Physiological, by increasing the tone of muscle, tendon and ligament.

(3) Reefing operations upon the capsule : (*a*) by plication, (*b*) by excision and overlapping.

(4) Repair of ruptured tendons and musculo-tendinous insertions.

(5) Muscle transplantation.

A fair trial of mechanical support and physiological toning up should be given in all cases before operative measures were adopted. Many cases had been cured by these means.

Reefing operations had undoubtedly been followed by many successes and not a few failures. Some of these failures might be due to the fact that the reef was described, almost invariably, as being taken from the part of the capsule which underlay the pectoro-deltoid septum, irrespective of the site of the original injury in the capsule.

Muscle transplantation had been performed by detaching the posterior fibres of the deltoid, passing them round the neck of the humerus and fixing them in front, so that they offered support to that part of the capsule which was weakened both in subglenoid and subcoracoid dislocations. Opinions differed with regard to the fate of the transplanted muscle. Some held that it retained its contractile power, others that it underwent fibrous degeneration and acted as an additional extracapsular ligament.

The following case was an illustration of a muscle transplant for an habitual subcoracoid dislocation :—

Major W. D. G., aged 41. Left shoulder dislocated in 1899 in Freshmen's match at Oxford. Number of redislocations : 1903-06, six times ; 1915, in Gallipoli, eight ; 1919, ten ; 1920, commenced for no reason at all, three. First seen in August, 1920. The left shoulder dislocated very easily ; the act of sneezing would produce dislocation. It was attended with much pain, and surgical assistance was required for reduction. The dislocation was subcoracoid. On August 18, 1920, Clairmont's operation was performed. By an incision extending through the anterior fibres of the deltoid, the quadrilateral space was defined by incising the upper fibres of the insertions of the pectoralis major and the latissimus dorsi. By a second incision extending through the posterior quarter of the deltoid, a flap of this muscle was freed, with its nerve and blood supply. If the muscle were separated with its tendinous insertion, it would be found sufficiently long to pass through the quadrilateral space, and be fixed to the cut anterior fibres of the deltoid in front. If more than a quarter of the deltoid were used as a flap its bulk necessitated an undesirable dilatation of the quadrilateral space. Sufficient dilatation was easily procured by passing forceps from the anterior to the posterior wound. It was important that the tension on the transplanted muscle flap should be sufficient, but not excessive. The shoulder had been fixed for three weeks: then active and passive movements had been employed and slowly increased in range.

It was too early to give a final report upon this case, but the following account written by the patient on February 20, 1921, six months after the operation, was hopeful: "For the first time since 1914 I have been able to get into a practice scrum and show, by demonstration, how to get the ball; so it looks as if the shoulder was fairly sound."

The patient was a games master at one of our large public schools, and had given them an opportunity, by his presence that afternoon, of estimating the present stability and mobility of his joint.

At the moment the discussion would probably centre round the relative merits of reefing and muscle transplantation operations.

Mr. T. H. Openshaw

showed a case of recurrent dislocation of shoulder (bilateral) in a male, a subject of epilepsy, operated upon fifteen years ago. The right shoulder had been "out" fifty times and the left thirty-five times. In dealing with the right shoulder he had tried injections of irritants—e.g., iodine, carbolic, &c., on four occasions; he cut the pectoralis major and teres major, he plicated the capsule, he performed an arthrodesis, all of which gave only temporary, if any, benefit. Finally he cut the subscapularis, and this cured him. On the left side he did an arthrodesis, and later divided the subscapularis. The result was excellent, but a fall produced a traumatic dislocation, and the recurrent trouble returned; he had the shoulder out three times in ten days. A second arthrodesis cured him.

He had operated on ten other cases of this sort, doing nothing but dividing the subscapularis, and all had been successful, and he knew of others treated in a similar manner with equal success.

Mr. Alan Todd

said that about a year ago he was investigating the results of dislocation of the shoulder-joint, and amongst the patients there were five who suffered from recurring dislocation of the joint. All the dislocations occurred in youngish working men, and all were attributed directly to an accident. Each of these men had been told that all forms of treatment, operative or non-operative, were unsatisfactory, and that as the condition was no great disability, they had better leave the joints alone. Every one of them, however, told Mr. Todd that they wished an operation done, because the state of their shoulder was such as to cause a marked depreciation of their wage-earning capacity; dislocation was constantly occurring, and therefore they were constantly having to go into hospital, and lose time, and sometimes a job also; whilst no employer would "take on" a man whom he knew to be suffering from a disability of this kind. Previous methods of treating these cases had undoubtedly been tedious and more or less unsatisfactory, but in Clairmont's operation they had a safe and sure method of treating them, and the profession generally would welcome this method as a great advance, as soon as it became sufficiently widely known.

It had been said that in making the posterior incision, to free the deltoid transplant, they must necessarily sever the nerve to the posterior fibres, and thus deprive it of its function as a piece of live muscle. That was not so, as anyone could see who would take the trouble, as he had done, to dissect it out carefully in the Anatomy Department. In stripping up the skin and fat from the fascia over the back of the deltoid, they could always clearly see the cutaneous branch of the circumflex nerve, standing out as a sort of prominent white cord, running between the deep and the superficial tissues; it was easy to trace this down to the main trunk of the nerve, which would be found to run right underneath the deltoid muscle, and then to break up; it sent a distinct branch backwards to the posterior fibres of the muscle, and this branch ran rather upwards, accompanied by an arterial twig; having seen this branch, it was perfectly easy to avoid it, and to keep the muscle-transplant both innervated and vascularized. Furthermore, it was not necessary, in any case, to take the posterior incision very high up; if a 4 in. incision were made with the lower end at the level of the deltoid insertion, that gave a flap amply long enough to be brought right round to the front, and there be sutured firmly. There was no need to go anywhere near the acromion, and it was hardly necessary even to approach the level of the circumflex nerve, provided that the muscle-fibres were freely separated from the adjacent parts. This separation, incidentally, should be by blunt-dissection, or by tearing apart, and not by cutting, thus also ensuring the safety of the nerve-supply.

In regard to after-treatment, he suggested that if the arm were supported on a shoulder-abduction splint, at right angles, the restoration of voluntary abduction would be found much easier, and the length of the convalescence about halved.[1]

Technically, the operation was not difficult, and it was certainly a great deal easier than pleating. It was all very well to talk about pleating the capsule, but it was a very difficult thing to do: the capsule in these cases was not a thick, redundant structure, as they might imagine, but a very thin one indeed, as a general rule; there was no localized bulge or tear, but the whole thing was simply membranous, and slightly too big for the head of the bone. It was almost a physical impossibility, as a rule, to get on stout artery-forceps, and lift up a fold, for the capsule promptly tore if they tried; moreover, even if it were possible, pleating would not be of much use, because the capsule was such a thin membrane that it certainly could not do much to prevent a dislocation occurring. Clairmont's operation, on the other hand, had been most successful, in everybody's experience. In his last case, that of a French governess, dislocation had occurred on countless occasions (twenty-two times in a month, before she came under treatment!) and, as in the President's case, it was induced by sneezing. Mr. Todd did Clairmont's operation, and she had not had a dislocation since, though she was back at her ordinary work. She last wrote to him four months ago; he had not heard from her since.

Mr. W. Rowley Bristow

showed a case of recurrent dislocation of shoulder-joints, right and left. History: Since joining the Army had suffered from fits and the shoulders often dislocated during the fits, but at other times as well. Patient stated that each shoulder had dislocated some fifteen or sixteen times. The dislocation had always been reduced by a doctor, but without anæsthesia as the patient preferred to put up with the pain, rather than have an anæsthetic. Had been unable to play cricket in 1918 and 1919 because "the arm came out" if he bowled. Operation (Clairmont-Erlich): Right, August 28, 1918; left, November 6, 1918. State, February 10, 1921: Right shoulder perfect. Played cricket and on an occasion bowled thirty-four overs in one game with no bad results. Left shoulder had "dislocated again" some five or six times. On the first occasion had been reduced by a doctor but since then "got it in for himself." Felt as if it "came partly out" but not right out, and pain was not so severe as formerly.

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[1] *Practitioner*, March, 1920.

Mr. A. W. Sheen

showed a case of recurrent dislocation of the left shoulder. B. T., male, aged 43. In June, 1915, dislocated left shoulder by falling off a lorry. Put in under an anæsthetic and arm fixed for some time. Been "out" nineteen times since; last in January, 1920. Had anæsthetic for reduction seven times. Had been "out" while sneezing and been pulled in by an orderly. When first seen eight months ago, movements were restricted, arm not being raised further than a right angle. Had been treated by physical methods and now had a strong arm with full movement. There was soft grating in the joint and the X-ray showed irregularity in region of greater tuberosity. It was a matter for discussion as to whether this patient should be operated on or not. The case showed the benefit of physico-therapeutics and there had been no dislocation for over fourteen months.

DISCUSSION ON RECURRENT DISLOCATION OF PATELLA.[1]

Mr. W. Rowley Bristow

said that recurrent dislocation of the patella was among the more uncommon lesions of the knee-joint, and when this condition was met with it was usual for the patella to be dislocated to the outer side. Two cases had come under his care rather more than a year ago. Both patients were males aged between 20 and 30. Neither presented signs of knock-knee. There was of necessity marked quadriceps insufficiency in the case in which the dislocation was persistent. The ligamentum patella did not seem to be elongated in either case.

Knock-knee—elongation of ligamentum patellæ and quadriceps insufficiency were given as the causes of this condition by Eisendrath in "Keen's Surgery," and by Goldthwait.

Goldthwait had published a paper on this subject in the *Boston Medical and Surgical Journal* (1904) and quoted eleven cases.

Whilst unquestionably the line of pull of the quadriceps was of importance, the three causative factors mentioned did not seem to him fully to explain the occurrence of the lesion.

Knock-knee and quadriceps insufficiency were both exceedingly common, but comparatively few cases of recurrent dislocation of patella were seen.

Elongation of the ligamentum patellæ was surely uncommon. In two cases in which he had reconstructed a ligamentum patellæ from deep fascia, following a rupture of this ligament, or rather a tearing off of the ligament from its patellar attachment, the newly constituted ligament was rather too long. In neither case did this inconvenience the patient to any great extent and certainly the patella never gave trouble. He would suggest that the disability they were considering was due to anatomical causes, and that the ridge on the external condyle of the femur was at fault. If this ridge formed an insufficient buttress, the patella was liable to slip too far outwards when pulled up by the quadriceps. Insufficiency of the vastus internus which normally corrected the tendency to outward pull of the rectus and external vastus, or alteration in the line of the limb, as in genu valgum, were accessory factors. Goldthwait described the condition as peculiar to young girls and women. Both his (Mr. Bristow's) cases were in adult males.

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[1] At a meeting of the Sub-section, held March 1, 1921.

The Treatment.—For the simplest cases a knee-truss, or redevelopment of the internal vastus, should be tried and might suffice. There must be border-line cases, and it was not straining the theory of causation which he put forward to imagine that the additional pull of a strong internal vastus might correct the tendency to outward displacement. A moderate ridge of the condyle and a good vastus might suffice when a moderate ridge and a poor vastus would fail to prevent the patella riding out too far. If palliative treatment failed and operation was resorted to, what should be done?

(1) If knock-knee was present it should be corrected. Neither of his cases showed this deformity and it had been noticed only once in Goldthwait's eleven cases. It was therefore probably hardly as common as was supposed.

(2) *Pleating of the Capsule on the Inner Side*.—He had no personal experience of this, but it seemed bound to fail. The laxity of the capsule would appear to be secondary, and if pleated they would expect it again to stretch. This had occurred in the three cases in which Goldthwait did this operation. All three relapsed.

(3) *Shortening the Quadriceps*.—Tubby described the operation: a transverse incision 2 in. above the patella, and a pleat ½ to 1 in. deep was taken up in the muscle and tendon of the extensor. Tubby was apparently satisfied with the result of this operation. Goldthwait reported one case: this one case relapsed. He (Mr. Bristow) had again no personal experience of the operation, which did not appeal to him as a rational procedure and appeared to be unsound, since it treated an effect of, and not the cause of, the condition.

(4) *Alteration of the Line of Pull of the Quadriceps by Transplanting one-half or all of the Patella Tendon to the Inner Side*.—He did not wish to make any claim to originality and was quite prepared to hear that that procedure which he adopted as an addition to the transplant was not new, although personally he had not come across any mention of it before. By his method, the whole tubercle had been transplanted well to the inner side, and fixed to a newly prepared bed on the inner surface of the tibia. Next, an osteotome had been driven into the femur immediately behind the external ridge of the outer condyle, levering this forward and so making it more prominent. A small wedge of bone had been removed from the tibia, from the original site of the tubercle, this site being already bare. This bone had been driven into the gap in the femur, firmly wedging the outer condyle forward, and fixing it into the position into which it had already been levered by the osteotome. The limb had been immobilized in full extension for five to six weeks, after which the patient was treated by physical means and encouraged to use the limb.

The case of old unreduced dislocation had yielded a good functional result. When he had last seen the patient there was some tenderness on pressure over the newly raised condyle, but no recurrence of the disability. He was walking well and was at work. In order to reduce the dislocation in this case, the capsule had been slit up on the outer side of the patella, and left open. No plication of the inner part of the capsule had been performed.

Both cases had been dealt with similarly, and neither had had any relapse. It was now about a year since operation.

He would suggest that transplantation of the tubercle with the tendon attached was a better procedure than transplanting the tendon alone, the union of bone to bone being better able to combat strain. He would further suggest that the bringing forward of the external ridge in the outer condyle was a rational surgical procedure, and only added a few minutes to the time of operation, even when a small bone-graft was driven into the femur.

Case I: Recurrent Dislocation of Patella of Left Knee.—Pensioner A. L. History: In 1915 left patella dislocated to outer side by direct violence—kick from horse. Since then dislocation recurred on four or five occasions. Sometimes the patient was able to reduce dislocation; on other occasions a friend did it for him. Operation, February 5, 1920: Tubercle transplanted to inner surface of tibia and sutured to bone in new position. External ridge on external condyle of femur levered forward, by driving osteotome in behind it. The space thus formed filled in by small bone graft taken from tibia. Capsule of joint split longitudinally on outer side. Synovial membrane not opened. State of patient, February 10, 1921: Working at Ministry of Pensions as clerk. Patella had not dislocated again, and there was full range of movement at knee-joint. Quadriceps still weak, but there had been very great wasting before operation in 1920. There was tenderness on pressure over transplanted tubercle.

Case II: Dislocation of Left Patella.—Pensioner W. J. H. History: In March, 1917, jumping over trenches, patella dislocated to outer side and after that never able to straighten knee. Walked with flexed knee, with the dislocation unreduced for over two years. Operation, January 22, 1920: Tubercle transplanted well to inner side. Bone drilled and tubercle fastened into new position. As capsule on outer side was contracted it was slit vertically and left open. Outer ridge on external condyle of femur levered forward with osteotome and small portion of bone removed from tibia wedged into the gap then formed. After-treatment: Immobilized in full extension for six weeks in a Thomas's splint. Physical treatment for some months. Bicycle riding: The patient considered that this exercise "did more good than anything." State of patient, February 10, 1921: Movement from full extension to about 80°. Was walking well. Knee still tender if knocked, but gave no trouble.

A cast taken before operation was shown.

Mr. O. L. Addison

showed a case of recurrent dislocation of left patella. W. G., male, aged 7. Admitted to Hospital for Sick Children, Great Ormond Street, January 7, 1918; discharged January 28. History: Loose kneecap for about two years. Mother had noticed that he fell down when walking. Condition first observed three months after fall downstairs. Was in plaster for six months. Examination: Well developed muscular boy; leg perfectly straight, great wasting of vastus internus; on bending knee about 35°, complete dislocation of patella to outer side of external condyle. Diagnosis: ? poliomyelitis affecting mainly vastus internus. Operation: A large reef taken up on inner side of capsule. Gracilis tendon divided at insertion, drawn taut through the split infrapatellar tendon and sewn in position. Apparatus limiting flexion had been worn about six months after operation. There had been no relapse since operation.

Mr. ALAN TODD

showed a case of recurrent bilateral dislocation of patella. Miss E. S. M., aged 37, school-teacher. Seen on February 19, 1921. History: No recollection of any trouble with knees before the age of 10, when she fell whilst skipping; patient believed that she had then dislocated the left patella. The dislocation had recurred from time to time, but she could do most things, except run or jump, till she was aged 20, being able to get about quite well, but being liable to fall. Each "attack" had been followed by some degree of synovitis, and as she grew older the synovitis became more persistent. Sometimes it had taken a fortnight or so to clear away. At this time a knee-cage of the Howard Marsh type had been suggested, and she wore one for fifteen years. Eventually, this appliance not proving entirely satisfactory, she had given it up, and she was now wearing instead some home-made metal pads, rather like Hawksley knee-trusses, bandaged on. The right knee had become troublesome also, special difficulty being experienced from its knack of luxating just as she began coming downstairs. Rather more than two years previously, she had experienced a severe fall, whilst coming downstairs, and the left tibia had protruded on the inner aspect of the knee-joint, and had been pushed back with a click. Stiffness and pain had lasted for over six weeks afterwards, and she stated that she had felt as if the "leaders" at the back of the joint had been "snapping" ever since. The left knee was liable, she said, to become suddenly fixed, from this cause, when she was walking; it always became fixed in a position of slight flexion, and remained painful till it was reduced. There was never any synovitis of the knee, however, after these attacks of "fixation." There was no knock-knee.

Condition on examination: Both patellæ could be easily pushed right over the outer edge of the femoral condyles; alternatively, as the patient bent her knees, the patellæ could be seen and felt to luxate somewhat outwards, and, as she said, it took a very considerable muscular resistance to prevent this happening. However tightly she strapped the knee-cage it failed to prevent it. Recently, she had even tried bandaging a large stone alongside the patella, to try to secure it, but in vain.

Operation advised.

The PRESIDENT (Mr. E. LAMING EVANS)

showed a case of recurrent dislocation of the patella. Sergeant L. G. C. "Knocking" injury to right knee in France, September, 1917, followed by synovitis and by slipping of patella outwards. The synovitis had cleared up but the slipping persisted. The patella slipped outwards, over the edge of the articular surface on the external condyle; the slipping commenced when the knee was flexed 30° to 40°, was at first gradual but when flexion reached 60° the patella suddenly jumped spasmodically to one side. The reverse phenomenon was seen when extension was carried out from the position of flexion. Operation, May, 1920: By a long outwardly curved incision from 3 in. above patella to 2 in. below tubercle of tibia, patella and ligamentum patellæ and the tubercle of the tibia had been fully exposed. The aponeurosis of the vastus externus and capsule had been divided laterally to the patella. One melon-seed body removed from the joint. Tubercle of tibia gouged by broad shallow instrument from tibia without fracture. With the same gouge a groove had been excavated on inner surface of tibia into which tubercle of tibia fitted exactly. It was fixed by forty-day catgut. Edges of capsule sutured and skin flap replaced. Leg fixed by plaster of Paris for four weeks in full extension. Massage and exercises employed for re-establishing flexion gradually. No recurrence had occurred; flexion and extension free, full and smooth from 180° to 80°.

Two photographs before operation and a series of X-rays were shown.

Mr. H. A. T. Fairbank

said he had operated on three such knees. He transplanted the tibial tubercle and overlapped the capsule on the inner side. In transplanting the tubercle he carried the incisions in the periosteum on either side of it down along the skin, and raised a strip of periosteum with the tubercle. This strip being left attached below, the continuity of the insertion of the quadriceps into the tibia was unbroken. In a child with habitual dislocation dating from birth, although there was no genu valgum when the knees were extended, there was definite valgum when the knees were flexed. Macewen's osteotomy was performed as well as the operation on the joint, and the result in both legs was entirely satisfactory when seen two and a half years later.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. W. Ernest Miles, F.R.C.S.

Three Cases of Fistula treated by Excision and Primary Suture.[1]

By Sir C. Gordon Watson, K.B.E., C.M.G., F.R.C.S.

The cases shown are three out of nine cases treated in a similar manner during the past two years at St. Mark's Hospital. One of the cases shown has been a semi-horseshoe posterior fistula. The average stay of these nine patients in hospital was three weeks and three days. The average stay of all cases of fistula treated by the ordinary method during the past two years has been six and a half weeks. Of the nine cases all except one healed successfully by first intention. One case broke down in part but healed well by granulation. Three out of the nine were treated with a smear of B.I.P.P. before suture. One case was proved to be tuberculous but healed in three and a half weeks.

With the experience of excision and suture of wounds during the War, I am now endeavouring to shorten the period of healing of simple cases of fistulæ. I quite realize that in the past this method has been abandoned as unsatisfactory but I think that under improved methods of technique, if the cases be selected with care, a distinct advance can be secured. Not only is time saved, but a good deal of discomfort and inconvenience prevented by avoiding daily dressings. I would emphasize the point that the fistulous tract was excised entire and only adjacent healthy tissue cut into. No sutures were passed through the mucosa. The entire tract was closed by passing deep silkworm gut sutures beneath the area of excision and the wound area kept dry afterwards with picric acid.

DISCUSSION.

Mr. Swinford Edwards said that whilst admitting that Sir Charles Gordon Watson had obtained excellent results in the cases he had brought forward, he felt that the risk of failure was not counterbalanced by the slight curtailment in the period of convalescence. Only simple straight fistulæ were suitable for immediate suture and they all knew what uniformly successful results were obtained in these cases by the open method. Union by first intention was somewhat difficult to obtain in the neighbourhood of the anus. The outward wound might break down or a stitch abscess might form necessitating a further operation.

Mr. Lockhart-Mummery said that Sir Charles Gordon Watson's results were excellent. Mr. Swinford Edwards had, he thought, missed the chief point with regard to the suturing of fistulæ, namely, that it was necessary to start by getting rid of the fistula by cutting out the whole of the fibrous tissue; one had then simply to deal with the large wound, which was sutured up so as to bring its walls into contact. There was nothing very new in the suturing of fistulæ: Mr. Lockhart-Mummery said that he himself had done a considerable number, but that they were done in the pre-war period. He gave the method up, not because there were no successes, but because there were too many failures. However, with the experience gained of the secondary suture of wounds during the War, and of their better knowledge of antiseptics, it seemed well worth while again attempting the suture of fistulæ. It was a question worth investigation whether direct immediate suture, the method adopted by Sir Charles Gordon Watson, was the best, or whether better results would not be obtained by secondary suture. Mr. Lockhart-Mummery hoped that other surgeons would try the method and report them to the Sub-section; he certainly intended to do this himself.

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[1] At a meeting of the Sub-section, held February 9, 1921.

Results of an Experimental and Histological Investigation into Seventy-five Cases of Rectal Fistulæ.

By W. B. Gabriel, M.S.

This investigation was undertaken with the object of ascertaining what percentage of rectal fistulæ was tuberculous, the proof required being the definite demonstration or isolation of the tubercle bacillus. The diagnosis of a fistula being tuberculous made on clinical grounds alone or on account of the presence of giant cells in sections of the granulation tissue is, I think, unsatisfactory and inconclusive, and in carrying out this work my object has been to show clearly that the tubercle bacillus was present in the lesion. The cases investigated have not been picked in any way; they were taken in succession as admitted into St. Mark's Hospital for operation, cases of peri-anal abscess being included in the series also.

Method of Investigation.

At first I examined the discharge from a number of cases, staining films by the Ziehl-Neelsen method. Although it is stated in books that tubercle bacilli are found in the discharge from tuberculous fistulæ, it was soon evident to me that this was a most unlikely way of finding the bacilli and I abandoned it. These cases are not included in this series. I then proceeded to carry out the following two main methods of examination:—

(1) By inoculation experiments.
(2) By histological methods.

(1) The inoculation of guinea-pigs with material from the fistulæ has been done in thirty of the seventy-five cases. At operation a sterile receiver was used to collect any discharge or scraping from the fistula and as much granulation tissue as could be excised; this was cut up into small pieces with sterile instruments as soon afterwards as possible, and all the material—pus, scrapings, and granulation tissue—was then treated with antiformin. The antiformin macerates the tissue, and destroys all pyogenic organisms, but leaves tubercle bacilli intact and viable unless the exposure is too long; three hours is the maximum, but a much shorter period is sufficient and advisable. For the last fifteen experiments I used a modification described by Wilson [1]. The material is thoroughly ground up in a sterile mortar with fine quartz sand, which reduces the tissue to a very fine state of sub-division: the whole is then washed with 10 to 20 c.c. of sterile normal saline solution into a large test-tube. The sand and larger particles sink to the

bottom, and the supernatant fluid, which contains the tubercle bacilli, if present, in suspension, is decanted off; to this an equal volume of 15 per cent. antiformin is added and allowed to act for five minutes with constant shaking or stirring. The solution is finally centrifuged, and the deposit is washed with saline solution and centrifuged alternately for half an hour. The residue is injected into the abdominal wall of a guinea-pig. After inoculation the animal is kept alive for at least six weeks, and is then killed and examined. In the infected cases direct films were made of any caseous nodules found, and sections prepared of the spleen or other organs involved.

I should add that in each of these thirty cases I examined a film of the finished antiformin deposit before it was injected, and in no case did I find any tubercle bacilli in the films. That the bacilli must have been present was shown by the result of the inoculations. This affords an idea of their relative scarcity in the tissues, which accounts for the extreme difficulty in finding them in sections.

(2) Histological examination has been carried out in all of these seventy-five cases. Portions of granulation tissue were excised from the fistulæ at operation, fixed in 5 per cent. formalin in saline for twelve hours, and embedded in paraffin and cut in the ordinary way. Some sections were stained with hæmatoxylin and eosin, and examined for giant cell systems; others, cut slightly thicker, were stained by a modified Ziehl-Neelsen method and searched for tubercle bacilli. Perhaps I might say a word with regard to this. The sections have an evil habit of floating off the slide after the decolorization with acid, and another trouble which I have found is that the counter-stain with methylene blue occasionally fades after a time; this I believe is due to incomplete wasting. I finally adopted the procedure advocated by Stitt [2]. The carbol-fuchsin is applied in the cold for half an hour; the stain is then poured off, and the decolorization done with 3 per cent. HCl in 50 per cent. alcohol, which takes about half a minute. The acid-alcohol is next diluted down with water and the section is very thoroughly washed with water to remove all traces of acid. The section is counter-stained with methylene blue and mounted in balsam, a No. 1 coverslip being used. It is advisable to cut and stain at least a dozen serial sections, and if the tissue looks suspicious it may be necessary to examine an indefinite number more.

For searching sections for tubercle bacilli I find that the easiest plan is to use a one-sixth objective and a ×8 eyepiece; the bacilli can be seen quite well after some practice, and the area of the section is covered more quickly than by using a one-twelfth oil-immersion lens from the beginning.

RESULTS.

The results fall into two groups: (I) Thirty cases investigated by inoculation experiments and by examination of sections; (II) Forty-five cases investigated by means of sections only.

Group I.—Six of the thirty inoculations gave positive results, i.e., 20 per cent. Dr. Thornton of the Middlesex Hospital very kindly did this part of the work for me, and his reports on the infected animals are as follows: "No. 34: Typical generalized tuberculosis of all organs; bacilli very numerous. No. 35: Caseous nodules in peritoneum; miliary tubercles in spleen; many acid-fast bacilli. No. 45: Spleen contains many miliary tubercles; many acid-fast bacilli; other organs show no lesion. No. 47: Caseous mass in peritoneum; spleen shows diffuse enlargement: liver shows several caseous areas; acid-fast bacilli numerous. No. 49: General miliary tuberculosis; lungs, spleen and liver mainly affected; all lesions show acid-fast bacilli. No. 56: Small white nodules in spleen; no other lesion." Section of this spleen shows acid-fast bacilli present in small numbers.

I have a note that in Case 34 (male, aged 49) the tubercle bacilli recovered from the guinea-pig were short, apparently bovine; in the other five cases the bacilli were long and beaded—typically human.

Five of these six positive cases were males, which agrees, I believe, with the usual opinion as to the relative frequency of tuberculous fistulæ in males and females. Their ages range from 21 to 62. In the three younger subjects —aged 21, 28, 30—the fistulæ complicated pulmonary tuberculosis (tubercle bacilli in sputum) and presented the appearance which is typical of a tuberculous fistula, i.e., the external opening had a discoloured, unhealthy-looking margin, there was a watery discharge, no induration, and, as a rule, extensive undermining of the skin.

In the three older subjects, all males, aged 49, 54 and 62 respectively, the infection seems to have been of a different nature. They were robust, healthy-looking men with no evidence of pulmonary tuberculosis, and the fistulæ did not present the characteristic appearance of a tuberculous lesion. Induration was present to a varying extent: the external openings were small, either single or multiple, but the feature to which I would attach most importance is a purplish discoloration of the skin for a varying area round the fistula, yet without any actual ulceration of the skin.

There is one point which these six cases of proved tuberculous fistulæ have in common, which is, that not one has healed completely. One of the younger subjects with phthisis is now in a chest hospital: the remainder are much improved in their general health, although the fistulæ still discharge slightly. I should add that in these six positive cases the fistula was the only local lesion found; there was no evidence, for instance, of there being a tuberculous proctitis with ulceration, with a fistula as a secondary complication.

The twenty-four cases which gave a negative inocculation result were clinically simple with one exception. This was a man, aged 35, who had evidence of pulmonary tuberculosis involving both apices, with tubercle bacilli in his sputum. His fistula was thought to be tuberculous. It was operated upon twice and healed up. In the section of the granulation tissue from this case no giant cells nor tubercle bacilli are seen, and the inoculation experiment was negative. This case may be regarded as an example of a non-tuberculous fistula in a phthisical subject; unless possibly the tubercle bacilli were missed in collecting the material for inoculation, and the cure resulted from the excision of the granulation tissue and application of antiseptics, aided by the reaction following operation.

With regard to the question of giant cells in the sections from this group, in the six positive cases well-marked giant cells are found in two cases (ages 21 and 28): they are mostly oval or round, regular in outline, with peripheral nuclei and a clear central area, and are associated with caseating areas in one case and with well-developed encircling layers of fibrous tissue in the other; in two cases (ages 54 and 62) a few giant cells are present, and in the remaining two cases (ages 30 and 49) they are absent. In the twenty-four negative cases giant cells are absent in twenty-two, and present in small numbers in two, the cells here being scattered, irregular in outline, with diffused nuclei.

I have examined sections stained for tubercle bacilli from the six positive cases, but have not succeeded in demonstrating the bacilli: they must be present but are very difficult to find. I must admit, however, that I have not searched so many sections as I have for the non-inoculation cases.

Group II.—I have succeeded in finding tubercle bacilli in stained sections in four of these forty-five cases, i.e., 9 per cent. The first was that of a male, aged 49, with no evidence of phthisis, who had an anterior horseshoe fistula; the skin was discoloured; there was a certain amount of induration. The fistula was laid open and healed well at the time. In sections of the granulation tissue many giant cells are seen in groups, and I show a section in which a definite tubercle bacillus is seen in the outer part of a characteristic giant cell, with a second bacillus in the interstitial tissue in the same field. I saw this patient recently; he has a submucous track leading up the bowel anteriorly, but is in good health generally.

The second case was that of a man, aged 39, who had a fistula discharging on the right side of the anus. At operation the whole ischio-rectal fossa was found to be excavated, and it was thought to be very probably tuberculous. There were no signs of pulmonary infection. Sections of the granulation tissue show very numerous collections of large giant cells, and I have found three tubercle bacilli, singly, inside giant cells (section shown). This case was operated upon in August, last year, and at present appears to have healed. His general health is good, and he is doing his work as a blacksmith.

I show the sections from the other two cases demonstrating the tubercle bacilli inside giant cells. One of the sections (No. 64) shows two tubercle bacilli in the outer part of a giant cell, and I have put this section under a one-sixth objective to show their visibility under this power. I need not describe these cases in detail; they were both males, aged 18, with definite pulmonary tuberculosis, and the fistulæ were clinically tuberculous.

The giant cells from these four positive cases are large, and show the clear central area which is commonly regarded as typical of the tuberculous giant cell. In one of the sections a tubercle bacillus was seen inside a large oval giant cell which had diffused nuclei: the next serial section showed the same giant cell with the nuclei beginning to be arranged peripherally, showing that the first section had evidently just cut the outer margin of the cell. In considering this feature, therefore, in a section the average appearance must be estimated. Another useful point, I think, is the presence of groups of polymorphs in relation to giant cells. One finds these collections of polymorphs frequently in sections of spleens from infected guinea-pigs, and I have found exactly the same appearance in sections of proved tuberculous granulation tissue, but never in non-tuberculous fistulæ even where giant cells were present.

I show one rather remarkable section; it was from a man, aged 29, who who had a short, superficial fistula clearly simple in character, which has healed well. The section shows large numbers of large giant cells. I have examined numerous sections for tubercle bacilli, but have found none. No macroscopic foreign body was found at operation in this case, but the only explanation that I can offer is that these cells are foreign body giant cells. They are found irregularly throughout the section and their nuclei are mostly diffused, but a certain number of cells are seen with peripheral nuclei and clear or necrotic centres.

Of the remaining forty cases, in two the fistulæ were suspicious, and sections show giant cells, but I have been unable to find tubercle bacilli in them. The rest were clinically simple; a few small giant cells to which I attach no significance were found in six, and in the remainder they were completely absent.

Of these seventy-five cases, ten had definite pulmonary tuberculosis—i.e., 13 per cent. This agrees with Mr. Swinford Edwards' statement that 12 per cent. of fistulous patients have phthisis, and with Harrison Cripps' estimate of 10 to 15 per cent.

No particular variety of fistula has been found to predominate among the positive cases: there was only one anterior horseshoe fistula. In the following table the positive cases are arranged in the order of age. The first five cases, ages 18 to 30, had active pulmonary tuberculosis; the second five cases had no evidence of lung involvement, and the question is whether or not in these cases the fistula resulted from a primary tuberculous infection. This is a difficult matter to decide; there was nothing in the histories to indicate that there had been former lung trouble, and all one can say is that in these cases the fistula was a proved tuberculous lesion, and that evidence of other foci was wanting.

TABLE OF POSITIVE CASES.

Number of case	Sex	Age	Variety and duration of fistula	Clinical appearance	Lungs	Section	Result
64	M.	18	Dorsal, two weeks	Tuberculous	Phthisis	G.C. ++, T.B. found	Not healed; no operation
72	M.	18	Left lateral sinus, two weeks	Tuberculous	Phthisis	G.C. ++, T.B. found	Not healed; drainage only
47	M.	21	Posterior horseshoe five weeks	Tuberculous	Phthisis	G.C. +, caseating areas	Not healed
49	F.	28	Dorsal, seven months	Tuberculous	Phthisis	G.C. +, encapsuled	Not healed
45	M.	30	Right lateral, one year	Tuberculous	Phthisis	No G.C.	Not healed
71	M.	39	Right lateral sinus, one month	Suspicious	*Nil*	G.C. ++, T.B. found	Healed
34	M.	49	Left lateral, three years	Simple	*Nil*	No G.C.	Healed: then broke down
60	M.	49	Anterior horseshoe, two years	Suspicious	*Nil*	G.C. ++, T.B. found	Not healed
56	M.	54	Right posterior semi-horseshoe, eighteen years	Suspicious	*Nil*	G.C. few	Not healed
35	M.	62	Right posterior semi-horseshoe, one year	Simple	*Nil*	G.C. few	Not healed

G.C. Giant cells. T.B. Tubercle bacilli.

In this series of ten positive cases one was not operated upon, and in another external drainage only was aimed at; of the remaining eight cases only one (Case 71) appears to have healed, and this is one of the apparently primary infections; the interval since operation is however only six months. I make the following suggestions as to treatment:—

(1) An unruptured ischio-rectal abscess in a patient with evidence of active pulmonary tuberculosis should be treated in accordance with the recognized principle applied to the treatment of cold abscesses elsewhere—i.e., by repeated aspiration with due aseptic precautions, and by the injection [illegible] ics

such as iodoform or flavine. If this fails the abscess can be laid open later in the ordinary way.

(2) In adults without evidence of phthisis the most reasonable method of treating a suspicious fistula if it is not too extensive, on the supposition that if tuberculous the infection may be primary, would seem to be excision of the infected granulation tissue, thorough swabbing with antiseptics and primary suture. This method would give the tissues the best opportunity of dealing with any bacilli left behind.

CONCLUSIONS.

(1) In tuberculous fistulæ the tubercle bacilli are very few in numbers, and are most certainly demonstrated by concentration with antiformin and by inoculation into guinea-pigs. By this method I have proved 20 per cent. of fistulæ to be tuberculous (six out of thirty).

(2) Tubercle bacilli may be found in stained sections of the fistulous granulation tissue, most likely places being inside, or in the region of giant cells. The sections should be cut moderately thick. By this means I have proved 9 per cent. of fistulæ to be tuberculous (four out of forty-five). The bacilli are so scarce that a negative finding is valueless until many sections have been examined.

(3) Other methods of demonstrating the bacilli are: (*a*) Examination of films of the prepared antiformin deposit; this proved negative in the thirty cases that I examined; (*b*) culturing the antiformin deposit on special media such as Dorset's, or the medium recommended by Wilson. I have had no experience of this.

(4) If histological examination only is carried out, and if no tubercle bacilli are found in sections a consideration of giant cells can only give a presumptive diagnosis. The presence of groups of large oval or round giant cells with peripheral nuclei, especially if associated with caseating areas, collections of polymorphs or well-marked fibrous tissue capsules, is in favour of the tissue being tuberculous. The absence of giant cells does not exclude the possibility of the tissue being tuberculous.

(5) Clinically, tuberculous fistulæ present their characteristic appearance best in subjects under 30. In older subjects the fistulæ are frequently not so characteristic, and are not so usually complicated with active pulmonary tuberculosis.

The question which remains for discussion is whether it would be advisable to investigate fistula cases by the inoculation method as a routine. From the scientific point of view the establishment of an accurate diagnosis and a criticism of end-results over a large series of cases is most desirable. From a practical point of view, in cases which are clearly simple in character, and in cases obviously tuberculous in young subjects, the experienced eye and finger will be able to give an accurate diagnosis and prognosis. But it is in the doubtful case of an adult, say between 40 and 60, in which the fistula looks a little suspicious, that a definite positive or negative experiment would be appreciated in giving a prognosis as to cure.

In conclusion I wish to express my thanks to my seniors at St. Mark's Hospital for their help in collecting material for this investigation, to Professor C. H. Browning for his advice, and to Dr. Thornton of the Middlesex Hospital for so kindly doing the actual experimental part for me.

REFERENCES.

(1) WILSON, *Brit. Med. Journ.* 1920, i, p. 146. (2) STITT, "Practical Bacteriology," 1916.

The Three-stage Abdomino-perineal Excision of the Rectum for Cancer.

By H. GRAEME ANDERSON, F.R.C.S.

THIS case has been brought to your notice for two reasons. In the first place it is an unusual type of case, presenting as it did two growths, one benign and one malignant, in the same rectum. The other and more important reason is that it is the first case on record, I believe, in which the abdomino-perineal excision of the rectum, as advocated by our President, has been carried out in three stages.

The patient, a male, aged 42, a milk carrier, was admitted to St. Mark's on September 22, 1920, with a history of two years' duration of dyspepsia, pain after food, colic, and diarrhœa. There was no vomiting and the appetite remained good. For three months before admission the diarrhœa had increased and was accompanied by the passage of blood and mucus. The patient also began to lose weight.

On examination a large soft pedunculated growth of the same colour as the rectal mucosa was found 3 in. from the anal margin. Above this and quite separate from it was found a second growth, hard, ulcerated and encircling the bowel with its lower margin at the recto-sigmoidal junction and just within reach of the examining finger tip. This interesting double condition was verified by sigmoidoscopy on September 24, 1920. Nothing else abnormal was found except some tenderness over the gall-bladder.

An innocent and malignant growth in the same rectum must be a very rare condition and is hardly mentioned in literature. I have seen a malignant growth in a case of multiple adenomata of the large bowel, and also two separate malignant growths in the same rectum, but this is the first case I have seen as described. Perhaps some of you may be able to tell me of other such cases.

Colostomy through the left rectus was done on October 6, 1920, and the bowel opened two days later. On October 20, under spinal anæsthesia (morphine and scopolamine), and in the later stage a little gas and ether, a wide perineal excision of the rectum was carried out. On opening the peritoneum it was found impossible to get above the upper growth, so the rectum was removed containing the innocent growth only. The bowel was sutured over just below the upper growth and sewn to the margin of the peritoneal opening. A drainage tube was inserted in the perineal wound which was sutured. A catheter was tied in the bladder.

On leaving the table his pulse was 72 and he was of good colour. His progress was uneventful except for a rigor the next evening.

On November 2, there was discharge of mucus from the perineal wound. On November 20, he was given a vaccine of 10 millions of mixed streptococci and *Bacillus coli*; and on November 24, he was given 8 c.c. of 1 per cent. nucleinic acid to produce leucocytosis. Later in the same day, under gas and ether given by Mr. Lloyd, the colostomy was sealed off and the abdomen opened in the midline from the umbilicus to the pubes. The liver and gall-bladder were found apparently normal and there were no peritoneal deposits or enlarged glands felt in the pelvic mesocolon. In the Trendelenburg position the small intestines were packed off and the inferior mesenteric artery and vein were ligated just above the pelvic brim. The pelvic mesocolon was then divided and vessels ligated. The pelvic colon was crushed 3 in. below the colostomy opening, divided, and the ends turned in by purse string sutures. A small blind end of bowel about 2 in. long was then left leading up to the colostomy opening. The peritoneum was then incised on either side of the pelvic mesocolon and these incisions were carried round in front. The lower half of the pelvic colon with its mesocolon was stripped down to the recto-sigmoidal junction where the second growth was situated. The bowel was carefully separated from where it had been united to the peritoneal edges in the second operation, and then the pelvic colon with the contained growth was removed. The peritoneal floor was easily sutured over. It was interesting to note that on the floor of the pelvis there was a small area, dark in colour and the size of a shilling, communicating with the perineal wound. But it was noted that the latter wound had to a great extent filled in. He left the table with a pulse of 72, and respirations numbering 14.

Next day his temperature was 99° F., pulse 80, and respirations 14. He passed urine naturally, had no sickness, retained salines, but complained of pain in the back. Two days after the operation he complained of pain in the stomach, but the abdomen was soft: his temperature was 101° F. On the 29th, his temperature was 102° F., pulse 88, respirations 20, but the abdomen moved well and there was no sickness. On the 30th there was a foul discharge of pus from the perineal wound and the temperature came down. A tube was then inserted in the perineal wound.

His progress after that was uneventful. He increased in weight and on December 27, he was up feeling fit and well, except for occasional pain on micturition. He was discharged a few days after onset of convalescence.

The treatment of cancer of the rectum by operation is one of the most debated subjects in surgery. At present there are two schools—one advocates the wide abdomino-perineal operation in one stage, so that all areas of potential spread are removed, while the other is content with a wide perineal excision only. There is no doubt that the first method is more sound on pathological grounds, but the one deterrent to it is the high operative mortality. Taking all surgeons' work, I would place the operative death-rate about 55 per cent. The operation which I have described to-day—i.e., the abdomino-perineal excision in three stages, will, I think, reduce this high operative mortality considerably. I strongly commend the method to you and would like to hear later of your immediate results.

Case of Ulcerative Colitis.

By Lionel E. C. Norbury, F.R.C.S.

J. C., aged 60, admitted to hospital on January 24, 1921, with an enlarged prostate and chronic cystitis, in a drowsy and semi-comatose condition. Incontinence of fæces with loose stools containing blood. No sloughs seen in stools.

Condition of urine improved with bladder washings, and he became less drowsy and asked for the bed-pan for the first time on January 30. The patient died on January 31.

Post-mortem: The colon from just above the splenic flexure, downwards, was dark red in colour and showed the presence of many ulcers. In several places the wall of the gut had sloughed and was on the point of perforating.

(The specimen showing the ulceration is exhibited.)

Mr. J. P. LOCKHART-MUMMERY showed a specimen from case in a female, aged 65, of Extensive Sessile Villous Tumour of Rectum, with Malignant Ulcer in the centre.

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Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.[1]

President of Sub-section—Mr. E. Laming Evans, C.B.E., F.R.C.S.

Case of Bilateral Radio-ulnar Synostosis associated with Bilateral Congenital Dislocation of Hips.

By E. Laming Evans, C.B.E., F.R.C.S. (President).

G. P., FEMALE, aged 5, first seen in May, 1918. Mother complained that the child was unable to roll the forearms.

Family history: Three sisters and one brother without deformity; no history of deformity in the family.

Upon examination, synostoses of upper ends of radius and ulna were found on both sides; forearms were in position of pronation.

In the routine examination of the child for other deformities a bilateral congenital dislocation of the hips was discovered. This was reduced in September, 1918, and I show you the X-ray before reduction and one taken in February, 1921, which confirms the physical examination that the treatment has been successful.

I have not attempted to treat the radio-ulnar synostosis for these reasons: (1) That the functional disability is slight and can largely be compensated by external rotation of the shoulder; (2) that attempts at nearthrosis have resulted, in the cases I have seen, in failure.

Mr. Aitken reported that he had recently had a case of synostosis of the radius and ulna in a girl aged 13, otherwise well developed and intelligent. The synostosis involved the superior radio-ulnar joint and extended down nearly to the bicipital tuberosity. An operation was performed on the left arm three days ago, by an incision along the posterior border of the ulna, separation of the anconeus from its insertion to the back of the olecranon, a further removal of the whole block of bone between the radius and ulna, including a considerable portion of the adjacent parts of both bones. When taking out this block of bone, the portion of muscle attached to the coronoid processes was pulled right through to the back. This was secured to the edge of the anconeus, and, when released, pulled the anconeus as a complete buffer between the two bones. Free rotation was possible at the time. Mr. Aitken said that he would report the result of the case in six months' time.

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[1] At a meeting of the Sub-section, held April 5, 1921.

Case of Multiple Cartilaginous Exostoses associated with Congenital Dislocation of Hip.

By E. LAMING EVANS, C.B.E., F.R.C.S. (President).

M. G., FEMALE, aged 9, first seen at age of 2 years 9 months in October, 1914, when left leg was observed to be shorter than right.

Examination showed dislocation of left femur on to dorsum ilii. Nothing abnormal detected either on femoral head or at site of acetabulum; thickened mass felt on anterior surface of left femur below level of great trochanter; also small irregular mass on crest of right ilium.

I made a note at the time that these masses were of the nature of cartilaginous exostoses. The case was not seen again until March, 1921, when it had developed into a typical example of multiple cartilaginous exostoses.

Family history: No history of deformity in either father's or mother's family; mother is a Roumanian and has five sisters in Roumania, so no great reliance can be placed upon the history. Patient has one sister aged 18, two brothers aged 13 and 11, all without deformity.

Exostoses can be felt on left femur, at insertion of adductor magnus and at upper end on anterior surface just below level of great trochanter; on left tibia, at insertion of sartorius; at lower end of left fibula. X-ray appearance of left acetabulum is strongly suggestive of a cartilaginous exostosis arising from the Y-shaped cartilage, but this cannot be confirmed by palpation. Exostoses are also present on right iliac crest, right femur and right fibula, lower end of the right radius and vertebral borders of scapulæ.

I consider that this is a case of so-called congenital dislocation of the hip in which the cause has been a shallowing of the acetabular floor caused by a cartilaginous exostosis arising from the Y-cartilage and projecting above the level of the floor of the acetabulum.

Case of Finger Injury.

By A. W. SHEEN, M.S.

MRS. E. G., aged 49, on December 11, 1920, fell and dislocated left ring finger at proximal interphalangeal joint, finger being bent to ulnar side. She pulled it in herself. Subsequent treatment was by massage and movements and later by strapping of joint. Much pain and swelling; these lessened but did not disappear; an X-ray on February 9, 1921, showed a chip fracture of distal end of proximal phalanx on ulnar side.

Present treatment is by massage, hot air and ionization and, as an absolute inability to extend completely has developed, a specially made little splint is worn to pull finger into full extension. Swelling still present; pain slight and intermittent; active movements good.

Antero-posterior and lateral skiagrams are shown. The disability is prolonged and would be incapacitating in a labourer. Opinions are invited as to treatment.

Mr. ASLETT BALDWIN said that some years ago, he had a similar injury to that described by Mr. Sheen, but at a different joint. The extensor ossis metacarpi pollicis was torn away from its insertion, bringing away a bit of bone with it. His hand was put into a gauntlet of poro-plastic, with the thumb abducted; it was fixed for about a month. Recovery was complete in about six weeks with no deformity.

Case of Chronic Arthritis of the Knee in a Syphilitic Boy.

By A. H. TODD, M.S.

C. C., NOW aged 9.

Family history: Mother rheumatic; has had four children, of whom three are living: no miscarriages.

History of present condition: First attended the Queen's Hospital for Children in June, 1918, saying that he had had "pains all over," on and off, for a month, and that at the beginning of the attack, his skin had come out in blotches. Deep reflexes were normal; nutrition was good; his knee contained no fluid and was not tender; temperature was normal. The diagnosis then made was tuberculosis of the right knee-joint, with erythema nodosum, and fading secondary nodules on the legs and arms. A Wassermann test, made shortly aftewards, gave a + + reaction. He continued to limp till December, when he had pain in the hips and ankles, and then pain and swelling of the right knee, lasting for over three weeks; his heart was found to be normal. He was admitted, with a diagnosis of ? rheumatism, but the pain, fluid and swelling persisted in spite of rest and salicylate treatment. In February, 1919, a splint was applied; a week later the movements were described as "fairly free and painless," but there was much more periarticular thickening. Pot. iodid. was now administered for the first time, and was continued for over a year. A second Wassermann, taken in March, 1919, was still +. The condition fluctuated in severity till June, by which time (the limb being in plaster) the pain had subsided somewhat. A third Wassermann, taken in June, was negative. In August, 1919, he was admitted, and a calliper splint was applied, instead of the plaster, and between then and now he has been re-admitted several times to have the knee straightened.

Present condition (March 15, 1921): Knee still puffy, especially on the inner side, above the patella; thigh 1 in. wasted; tenderness on moving patella laterally across femur; flexion much limited. Wassermann negative. The teeth and eyes are normal, and the patient shows no signs of congenital syphilis, except that he is somewhat deaf; the aurist reports, however, that he cannot find any lesion of his auditory nerve.

Skiagrams show marked rarefaction of the bones of the right knee-joint, together with considerable erosion of the articular cartilages, and the surface of the underlying bone. The appearances are very like those seen in tuberculous knees, but the destruction of the articular surfaces is rather greater than one would have expected in a knee that shows so little evidence of activity at the present time.

The main interest of the case lies in the question as to whether the case is one of true syphilitic arthritis, or one of tuberculous disease in a syphilitic child, and it is shown mainly in the hope of stirring up some discussion upon this matter. When I was an Out-patient Officer at Guy's Hospital, I used to have Wassermann tests made, as a routine, upon all patients who had any sort of chronic arthritis; some of them proved to be positive, and of these particular cases, some presented close analogies to tuberculosis, whilst others looked like rheumatoid arthritis, or even osteo-arthritis. Whilst I was careful not to assume that a positive blood test meant that the disease present was actually caused by syphilis, I gave salvarsan to all those who had positive reactions, and some of them not only got rapidly well, but remained permanently well. That opened my eyes to the fact that numerous cases, diagnosed as tuberculous or other chronic arthritis, were really and truly syphilitic, and I advocate the examination of all patients who have chronic arthritis of any sort by the Wassermann test as part of the routine examination.

It has been suggested that syphilitic persons are more liable than normal persons to tuberculous infection. That seems to me to be a confusion of thought, and we shall never make any progress as long as we "hedge" in that way. Besides, we can draw an analogy from other groups of known syphilitic cases: in the eye department, we see innumerable children with interstitial keratitis, and they are certainly syphilitic; yet their general health is often very good, and I do not remember ever having seen one of them who was afflicted with a tuberculous joint.

In my experience, syphilitic joints rapidly get well under vigorous antisyphilitic treatment, if they are diagnosed early, and heal very slowly, or not at all, if antisyphilitic remedies are only used late in the case. In this case, it might be argued that the persistence of pain, swelling and limitation of movement after so much treatment were in favour of tuberculous disease. On the other hand, the left knee seems to me to be not quite normal; the posterior surface of the patella, in the radiogram, shows a distinctly crenated and rather "fuzzy" appearance, which is different from the very clear and definite outline that the bone normally has at this age. If, as I think, that indicates that the left knee is involved as well as the right, it would be a strong point in favour of syphilitic arthritis, and would make the diagnosis of tubercle much less probable.

Case of Osteitis Deformans of Left Tibia.

By Paul Bernard Roth, F.R.C.S.

Mrs. A. T., aged 52, attended hospital on March 22, 1921, complaining of bending and enlargement of the left shin bone. She stated that it had been bending for the last three or four years, and attributed the enlargement to a kick she received fifteen years previously.

Examination showed enlargement of the shaft of the left tibia to about twice its normal thickness, with marked bowing of the bone, the convexity of the curve being forwards and outwards. The only disability complained of is pain in the bone on any change of weather.

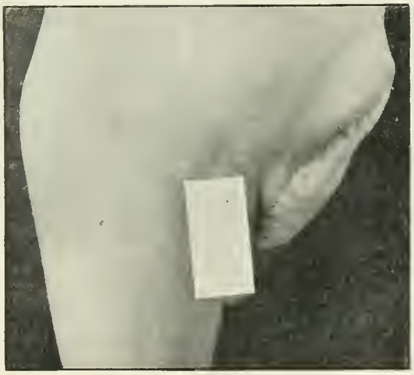
A radiogram taken by the late Dr. W. Ironside Bruce shows "distinct thickening of compact bone and narrowing of medullary cavity, strongly suggesting osteitis deformans."

Amputation at the Hip-joint by a Posterior Flap.

By M. Fitzmaurice-Kelly, F.R.C.S.

THIS method is designed to leave as little redundant tissue as possible, so as to facilitate the fitting of a "tilting-table" limb. The anterior incision is parallel to Poupart's ligament, extending from above the great trochanter to the adductor region; a posterior flap is marked out, and the amputation is then performed from the front, cutting all muscles short. The head of the femur is usually left, the neck being divided close to it. In the case shown this was done, but a part of the iliacus left too long became adherent to it, and caused a dislocation of the head, which necessitated its subsequent removal.

The resulting stump is shown in the photograph. This is the eleventh case done by this method, and the others have been satisfactorily fitted.



Case of Hæmatocele of the Knee-joint.

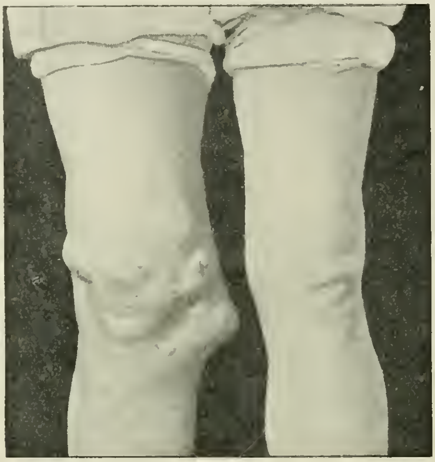
By M. Fitzmaurice-Kelly, F.R.C.S.

THIS case, J. H., aged 54, was shown two months ago as a case for diagnosis. Shortly, the history was of injury to the right knee, for which drainage was undertaken, in 1902; the patient recovered sufficiently well to ride twelve months later. He served in the War, and in April, 1919, had a second severe contusion of the joint. There is great swelling of the knee-joint, bulging at the site of the old incisions, and masses in the popliteal space and over the inner tuberosity of the tibia (*see* figure p. 170). A skiagram shows opaque masses in the region of the swellings and in the supra-patellar pouch; no bony change. Movement free and painless, but patient tires easily.

Operation on the mass over the inner tuberosity of the tibia disclosed a multilocular mass, containing a little fluid resembling synovia, but chiefly a solid mass resembling altered blood clot. Nothing was obtained on aspiration of joint.

On microscopical examination unaltered synovial membrane of the bursal wall was seen in places and laminated blood clot. No sign of new growth.

I have not been able to find a similar case in the literature. Nicaise[1] reports a case in which he found unabsorbed fibrinous clots in the knee-joint at an autopsy fourteen months after an accident; this is the only reference bearing even remotely on the case that I can find. The condition resembles in its pathology an old hæmatocele of the tunica vaginalis more than any condition I have met, and therefore I have ventured to call it a hæmatocele of the knee-joint.



Case of Tuberculous Dactylitis.

By P. Maynard Heath, M.S.

The patient is an unmarried woman aged 31. Her illness began ten years ago with enlarged glands in the neck. She was taken to hospital and was said to have enlarged glands all over her body. Seven years ago the right thumb became painful, and swelling followed in two or three days. The pain ceased after two months. Gradually all the fingers became affected. A gland in the neck was aspirated four years ago, and this was followed by the appearance of lupus on the face and neck. She was treated for ulceration of the cornea five years ago, and she had suffered from winter cough since the age of 7. There was an attack of hæmoptysis at Christmas, 1920, and on four occasions since. There is no definite history of tuberculosis in the family except that the mother's sister has two daughters suffering from phthisis. At the present time the hands are extensively crippled by firm swellings, apparently involving the tendon sheaths of all the digits. Considerable deformity is produced and the movements of the fingers and thumbs are limited. The glands on both sides of the neck are enlarged and there are patches of lupus on the face and neck. There are signs of phthisis in the upper lobe of the right lung.

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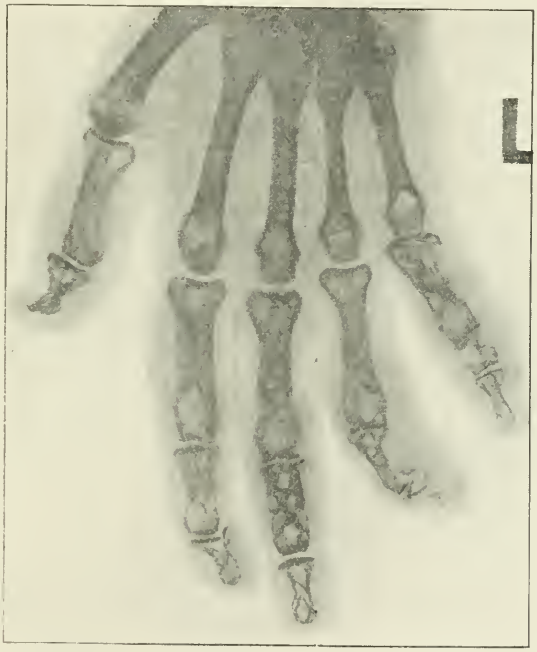
[1] *Bull. de la Soc. de Chir. de Paris*, 1876, ii, pp. 750-755.

X-ray examination of the hands shows well-defined areas of rarefaction surrounded by somewhat sclerosed trabeculæ, so that an appearance of lacework is produced. All the phalanges are affected and some of the metacarpals show a similar condition to a slight degree. Some of the phalanges are expanded and some disintegrated. There is no evidence of periosteal new bone formation. There is some absorption of the interphalangeal joint cartilages (*see* figure).

X-ray pictures of the feet show similar changes in the phalanges and fifth metatarsals, though clinically the feet are unaffected. No changes have been detected in the long bones.

The Wassermann reaction is negative.

The hands have been treated by Bier's passive congestion method, the application of dry heat and the inunction of colloidal iodine oil. Very slight amelioration has been produced.



Mr. ASLETT BALDWIN said that since seeing Mr. Heath's case he had fetched from home the radiographs now shown. The patient was a girl aged 12. Since the age of 4, tumours of many of the bones of both hands had appeared. The X-ray appearances were very like those in Mr. Heath's case. Through lateral incisions, he (Mr. Aslett Baldwin) had curetted away all the tumours. Microscopically they were enchondromata. The material removed resembled, in appearance and consistency, slightly damp lump sugar. The case was doing well; the cavities were becoming filled with new bone.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. W. Ernest Miles, F.R.C.S.

DISCUSSION ON PRURITUS ANI.[1]

Mr. P. Lockhart-Mummery

said that the subject brought forward for discussion was, in his opinion, a most important one, and one upon which comparatively little was known.

He would like to say how deeply all of them regretted that Dr. Ironside Bruce was no longer with them to be one of the openers of this discussion, as he was to have been. Dr. Ironside Bruce had, he believed, done more than any other radiologist for this particular branch of rectal disease, and his contribution to the discussion would have been of the very greatest value. They all regretted that so valuable a member of their profession should have been added to the list of martyrs to scientific discovery at such an early age.

Pruritus ani was a peculiar condition from the fact of its having only one symptom—namely, itching. It had no properly established pathology, and they were still very much in the dark as to its cause, or the best method of treating it. It was by no means the trivial complaint that its name would seem to imply. The irritation was often so intense as to be almost unbearable and to drive the patient to the verge of madness. The insomnia which often accompanied it was serious, and, indeed, they all had seen patients who were very seriously broken down in health simply as a result of the irritation.

Probably most would agree with him that the thickening of the skin, the rugæ and eczema, fissures and other abnormal conditions of the skin around the anal orifice, which were so frequently seen associated with pruritus ani, were purely secondary results of scratching, and beyond the fact that they tended to accentuate the itching and interfere with treatment had no causal relationship with it.

He did not propose to deal with those cases of pruritus which were due to some general condition such as glycosuria, gout, diabetes, &c., or even with those due to some definite parasite. Such cases were important and should always be looked for, but they did not present any particular features of interest or difficulty in treatment

Certain definite types of pruritus ani might be distinguished :—

(1) Those due to some general condition such as glycosuria, &c.

(2) Those due to some parasite such as worms, pediculi, &c.

(3) Pruritus obviously secondary to some lesion of the anal region such as fissure, prolapsed pile, &c.

(4) Pruritus of old standing where no local lesion could be discovered.

(5) Paroxysmal pruritus.

Most observers would probably agree that a local cause for the itching was present in a great majority of cases, and the first essential on seeing a case was to make a thorough and careful search for this cause. In his experience where a definite cause for the pruritus was discovered that cause was generally one which produced a certain amount of moisture of the parts, more particularly of a septic character, such as fissure or fistula, a polypus of the rectum, or a prolapsed pile.

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[1] At a meeting of the Sub-section, held April 13, 1921.

He had found that where the itching was of recent origin the removal of the cause was followed by prompt and permanent relief of the irritation.

The most difficult cases were those in which no local cause could be discovered; this applied particularly to the paroxysmal cases in which it was quite unusual to find any local lesion.

The following definite facts relating to this curious condition had arrested his special attention. First, cases of pruritus ani with a history of only a few months or weeks were easily cured by the removal of some local cause, or by some simple application. Secondly, cases of pruritus ani with a history dating back for more than two years were very difficult to cure, and the removal of the local lesion, even if present, seldom stopped the itching. Was this the experience of other observers?

The conclusion would appear to be that if pruritus ani had existed in at all an aggravated form for a long time definite changes took place in the skin, or more probably in the nerve endings in the skin, which rendered the condition more or less permanent and prevented effective treatment. He believed these changes to be of the nature of a fibrosis in the deeper layers of the skin, involving the nerves, more especially the nerve end-plates in the dermis, and to be caused by the constant scratching and rubbing of the parts. In fact, in these old-standing and severe cases of pruritus an actual disease of the nerve endings in the skin existed. This had been first realized by the late Sir Charles Ball, who had insisted on the fact that a definite nerve lesion was the underlying cause in such cases.

In 1912 Dr. Dwight Murray had put forward the theory that pruritus ani was due to a chronic streptococcic infection of the skin of the anal region. He had pointed out that careful investigation by bacteriological methods proved the presence of *Streptococcus fæcalis* infection in the vast majority of cases. Mr. Lockhart-Mummery thought there could be little doubt of this and that further investigations by Dwight Murray and others had since established the truth of that theory, which was also supported by the fact that a septic lesion of some kind was the common starting point of pruritus. Also chronic septic foci of the skin in other parts of the body were frequently accompanied by intense irritation. It was possible that the disease of the nerve endings in these old standing cases of pruritus ani was due rather to this infection than to any immediate result of the scratching.

Further investigation on these lines was very necessary, but unfortunately there were many difficulties. It was difficult to obtain portions of skin for histological purposes from patients suffering from the disease, and histological investigation of the nerve endings of the skin was a very arduous undertaking requiring much patience and very skilful investigation.

With regard to the question of treatment, he did not propose to recount one tithe of the remedies which were used for this condition, but would only attempt to describe the broad lines on which treatment might be conducted.

He did not believe in general treatment, such as dieting, non-smoking, total abstinence, &c., as he thought they should try to cure the condition and not make the patient a slave to his anal region.

Local Applications.—Rigid attention to cleanliness, and more particularly to dryness, of the parts was very important and for this reason he believed lotions and powders to be better than ointments or greasy applications.

If a local cause, such as a fissure, ulcer, pile, hypertrophied papilla, &c., was present, it should be removed, and if no such cause could be discovered by ordinary inspection it was often advisable to administer an anæsthetic and thoroughly to investigate the anal region with a view to the discovery of the origin of the trouble.

Where the pruritus had been present for a long time it was very unwise to promise the patient that a cure of the fissure, &c., ulcer or pile, would in any way remedy the irritation, which was the subject of his chief complaint. They knew from experience that local treatment frequently failed in this respect. And it was not sufficient merely to find some application that would relieve the itching, but one must aim at initiating some definite line of treatment that would cure the patient, so that in the future there would come a time when further treatment was no longer necessary. It was a common experience that applications which relieved the itching, often failed after a month or so to be of any use.

Dwight Murray, basing his argument on the theory of streptococcic infection of the skin, suggested the use of a vaccine. This had never appealed to him (Mr. Lockhart-Mummery), as it did not seem reasonable to treat a septic infection of the skin by vaccine. Antiseptics, such as alcoholic solution of iodine, however, might be used either simply painted on or, better still, applied by ionization. Zinc ionization, or the application of nitrate of silver 30 to 60 gr. to the ounce, had also in his experience given good results. While such treatment was very effectual in some cases, in others it entirely failed to do more than temporarily relieve the itching.

X-rays.—It had been his experience that X-rays applied to the skin through suitable screens would cure about 20 per cent. of the bad cases of pruritus ani, and that the cure was permanent; but that in something like 80 per cent. it entirely failed to remedy the condition. Two or three applications were usually sufficient. A word of warning with regard to the use of X-rays in these cases was necessary, as he had had the unfortunate experience of having to treat several very bad burns, and one case of epithelioma of the anus in a young woman, that had resulted from X-rays applied for this purpose. It was unwise to persist with the rays if a very marked improvement did not follow two applications.

Operative Treatment.—After all these methods had been tried there still remained a certain number of cases in which the pruritus was not in any way remedied, and in which something had to be done. Experience seemed to show that no operation which did not destroy the diseased nerve end-plates in the dermis would remedy many of these old standing cases of pruritus.

Twenty years ago such cases had been treated by excision of the anal skin, or by the drastic application of the actual cautery. It had been found that only the complete destruction of the skin cured the condition. Unfortunately the results of such operations had been bad owing to the very severe scarring which necessarily resulted.

No such drastic measures were now necessary. The late Sir Charles Ball, in a paper published in the *British Medical Journal*, January 21, 1905, had described an operation, with which they were all familiar, for the division of the cutaneous nerves passing to the skin in the anal region. This operation had since gone by his name, and in his experience had proved most satisfactory. He had performed it at St. Mark's Hospital ever since 1905 with excellent results. Other surgeons had, he knew, tried this operation and condemned it because they had had failures, due, he believed, to their not having understood it. It was essential that the whole of the irritable area of skin should be rendered completely anæsthetic. The day after the operation the patient should be quite unable to feel the prick of a needle anywhere within the flaps, or at the anal orifice. If this anæsthesia was not obtained the operation had not been properly done and could not be expected to succeed. It was surprising how easily some of the nerves could be missed, and the failures that were often attributed to the operation were, he was convinced, due to this. He knew his own failures had been due to his having failed to divide the nerves completely. In raising the flaps the skin should be undercut to well above the level of the internal sphincter, otherwise the nerves would not be destroyed at all.

The results of the operation were that it gave immediate relief, and that it left no disability. Normal sensation returned completely within six weeks, generally within four. In the vast majority of cases the cure was permanent.

He had now performed this operation in fifty-nine cases. There had been a slight recurrence of itching in seven cases. Four of these had been easily cured by a simple application, and in three cases the operation had been repeated with complete success, so that as far as was known all the patients had been cured. There had been no serious complication, and no patient had remained in hospital or in a nursing home for more than six weeks, the average time being under three weeks. In all his cases normal sensation had been completely restored, and there was no disability of any kind.

He believed Ball's operation was the best treatment for all bad cases of pruritus ani, and that failures ascribed to it had been due to the surgeons having failed to properly divide the nerves.

To sum up he would put forward the following propositions for their consideration:—

(1) Pruritus ani was started by constant dampness of the anal skin, probably associated with streptococcic infection of the dermis.

(2) In cases of recent origin removal of the cause and the application of suitable treatment would result in a cure.

(3) When the pruritus had been present for a long period removal of the cause, such as fissure, piles, &c., would very seldom stop the itching, and local application only gave temporary relief. The reason for this was that a definite pathological change had taken place in the dermis involving the nerve end-plates.

(4) In old standing cases of pruritus a cure might in a few cases follow the application of X-rays, but in the majority of such cases Ball's operation should be performed.

Dr. WHITFIELD

said he had listened with much interest to Mr. Lockhart-Mummery's paper, with most of which he found himself in agreement. He thought however that the last group of cases to which Mr. Lockhart-Mummery had referred, namely, those in which no apparent cause could be found, should be regarded as only a provisional class and that every effort should be made to find out the hidden cause which, after all, must exist.

He would lay especial emphasis on the importance of determining the presence or absence of oxyuris in the bowel. It was not sufficient to ask the patient whether he suffered or ever had suffered from threadworms. There were undoubtedly considerable numbers of adults suffering from pruritus ani which was due to the presence of oxyuris, though the patient had no idea that he was infested by them. He had seen a case in which Ball's operation had been done for intolerable pruritus ani and had failed to give permanent relief. In this case he had examined the anus and had been lucky enough to see and demonstrate to the family doctor an oxyuris coiling and uncoiling itself on the mucous membrane outside the sphincter. This was obviously a piece of good luck, but the presence or absence of these worms could be determined with almost complete certainty by means of a test administration of thymol.

Some two and a half years ago a young lady with intolerable pruritus ani had been sent to him for treatment with X-rays. The anal region was apparently perfectly healthy. He had given a single dose of three-fifths Sabouraud pastille and recommended that a test administration of thymol should be given. This was not done and the itching had all stopped for over two years. A week or two ago this patient had returned for a further dose of X-rays but hearing that the test had not been carried out and having changed his views somewhat about the X-ray treatment, he had advised the thymol test before giving another exposure to X-rays. The result had been the detection of the oxyuris in fair quantity.

He thought that most medical men were much too optimistic in their views as to the ease with which patients were completely cleared of the worms. The thymol cure was the only one which he had found in the least efficient, and even with thymol he found it often necessary to repeat the treatment for several cycles. He was of opinion that a large number of the cases of pruritus ani in which no cause was found were due to oxyuris.

Turning to the question of the streptococcic infection and the vaccine treatment he said he had cultivated this organism from several cases in which there was maceration and erosion and had used a vaccine with considerable though not invariable success. He thought it was a valuable adjunct to other treatment.

As regarded treatment with X-rays he had now almost given this up. It was true that almost every case was benefited by every dose but the alleviation was temporary only. However careful one was with dosage and time interval one nevertheless reached a total dosage which was the maximum amount that could be given to one area without severe damage. The patient was therefore left at last with X-ray treatment exhausted and his pruritus still extant. In a case of eczema of the hand years ago he had given a total dosage equal to nine pastille doses spread over an interval of more than three years. No erythema had ever been produced and the only immediate effect had been the disappearance each time of the eczema, yet six months after the last dose an indolent ulcer appeared which had to be excised to get healing. He had examined the ulcer and the surrounding skin, excised and found it a typical X-ray ulcer with complete disappearance of the elastic tissue. He therefore warned against over use of the X-rays even when no immediate disturbance was caused.

Lastly, on the question of local applications, he found himself in complete agreement with Mr. Lockhart-Mummery in that lotions, especially spirituous lotions, were generally better than ointments. Where ointments were indicated they should not be sticky. He regarded wool-fat as the worst base and had devised a special non-sticky base consisting of one part of soft paraffin and three of coco-nut oil as the best excipient for drugs.

Dr. J. M. H. MacLeod

said that he would confine his remarks to what might be termed non-surgical cases of pruritus ani, i.e., cases due to medical or dermatological causes and not to lesions such as fistulous openings about the anal valve, deep cracks between the sphincters, polypi, tuberculous ulcers, hæmorrhoids or tumours in the rectum or pelvis, obstructing the venous circulation.

In his experience one of the most common medical causes of the symptom of pruritus ani was constipation or the incomplete emptying of the sigmoid flexure and rectum from the unnatural position in defæcation necessitated by the ordinary water-closet seats. Another common cause was congestion of hæmorrhoidal vessels due either to imperfect action of the liver or reflexly produced by and occurring almost immediately after taking some indigestible food, alcohol, especially red wine, and in many cases coffee. He had known it occur in a marked degree in connexion with glycosuria, and he need not refer to that common cause in children and occasionally in adults, namely threadworms. In such cases no local lesion might be present, however severe the pruritus, unless it were the secondary effects of rubbing, scratching, or the inoculation of pyogenic organisms. Such cases were commoner in males than females, possibly because they were more given to excess in eating and drinking.

In dermatological practice pruritus ani was frequently met with in connexion with diseases such as eczema, psoriasis, lichen planus, boils, and, last but not least, ringworm.

In eczematous subjects, patches about the perineum were frequent, and scratching about the anus was extremely liable to produce an eczematous patch. Such lesions were associated with intense itching, cracking of the skin, especially in the gluteal fold, and weeping.

Psoriasis might also be responsible for it. Recently he had seen a man who had been sent to him on account of this symptom, and on examination he had been found to have a well-defined pinkish-red patch around the anus, extending forward to the scrotum, which was intensely itchy, and proved to be psoriasis, as concomitant patches were present on the knees and scalp, these had given rise to no subjective symptom, and were of such a trivial character that they had been missed previously. The psoriasis lesion at the anus on the other hand, had obtruded itself, as it had been irritated by the moisture about the anal fold and by defæcation.

In cases of lichen planus he had in one or two instances noticed lesions about the anus, and in one case these were of a hypertrophic character, and had given rise to intense irritation. But apart from true lichen planus scratching and rubbing the skin for the relief of pruritus ani due to some internal cause was liable to produce a shiny thickening of the skin or "lichenification," in which the thickened epidermis, by irritating the nerve endings, itself produced itching. Consequently a vicious circle was created and the more the rubbing, the greater the thickening and the more intense and prolonged the pruritus.

Ringworm about the anus associated with ringworm about the groins was by no means uncommon, and was usually of an eczematoid character. It occurred around the anus as well defined moist red patches with a scaly irregular festooned border beyond which there were small vesico-pustules on a red base or the dried-up remains of them. In such cases the diagnosis was established by a microscopic examination of the fungus which was usually the *Epidermophyton inguinale.*

The treatment of cases in which the pruritus was due to some skin disease consisted in that appropriate to the dermatitis.

In those cases in which the cause was internal but in which the skin was thickened and the nerves were pressed upon, great benefit could be derived from X-rays, and he had found that three half-doses at intervals of a week were sufficient, great care being taken to protect the testicles by the use of a lead glass localizer. Radium was of equal value and he had obtained good results in a case from short exposures of five to seven minutes on two consecutive days with a half-strength applicator unscreened. Painting the thickened skin with salicylic acid 6 per cent. in 50 per cent. alcohol, or with 95 per cent. carbolic acid followed by zinc oxide dusting powder was of benefit, but it was inferior to either the X-rays or radium, and the actual cautery which was sometimes recommended for this purpose was too painful.

For the relief of itching without definite thickening where no local cause could be detected, the action of X-rays in paralysing the nerve endings was probably more effectual than anything else. Apart from the rays, carbolic acid 1 in 20, alone or combined with hyposulphite of soda as in the following formula—

Ac. carbol.	2 parts
Sod. hyposulp.	24 parts
Glycerin	24 parts
Water	50 parts

seemed to be as good as any local application. Cocaine and morphia were better avoided on account of the danger of establishing a drug habit. Cracks or superficial abrasions could be healed by the X-rays or fairly satisfactorily by ionization with a 2 per cent. solution of sulphate of zinc. Another useful treatment simply consisted in painting the cracks with 5 per cent. argyrol or in the employment of collosol silver suppositories, when the cracks or abrasions were inside the orifice.

Sir CHARTERS SYMONDS

insisted on the need for cleanliness and dryness. The application of wool would prevent friction; he preferred salicylic wool. He advocated the use of organic silver preparations such as protargol or argyrol, in 10 per cent. to 20 per cent. solutions. They were non-greasy and should be put on after the part had been cleansed with lysol and dried thoroughly.

Dr. FINZI,

speaking as a radiologist and discussing only the special methods he used, said that his results were somewhat similar to those of Mr. Lockhart-Mummery, though he believed he had a larger proportion of permanent successes than 20 per cent. of cases; he had not, however, seen anything like such large numbers of cases as Mr. Lockhart-Mummery. He found also that almost all cases were temporarily relieved by X-rays. Radium, he found, yielded more permanent results than were obtained with X-rays, and he attributed this difference from Dr. MacLeod's results to the fact that he always used a screen of 0·5 mm. of silver or 0·5 mm. of platinum on his radium when treating these cases. There were two ways of applying X-rays: (1) By full doses given every three weeks, and (2) by smaller doses administered every week. The amount of rays that could be used was limited, but it was considerably more than one or two full doses. The cases in which burns had occurred had been treated with X-rays for prolonged periods. Generally it was not a true X-ray burn, but an infection of tissues that were damaged by X-rays. In cases in which X-rays had failed, high frequency applied with a vacuum electrode often gave considerable relief, and this was a treatment that could be continued indefinitely if applied with care.

Sir CHARLES GORDON WATSON

said that certain cases were medical rather than surgical. Such were those that occurred in neuropathic individuals or in patients with a hereditary tendency—functional cases. He instanced the condition occurring in father and son. Surgical cases could be divided into two classes: (1) Those in which there was a real cause at the anus, and (2) those in which there was no marked disease. Cure was doubtful when dermatitis was well established. While the skin remained pliable the condition would respond to ionization. In 1909 he had treated twenty-eight cases with zinc ionization, which was followed by much relief after the first treatment. Many patients had five, six or seven applications. When the condition was paroxysmal some cases were functional, and some, he thought, were due to hypertrophied anal papillæ. Out of eighty-six of his cases of pruritus ani at St. Mark's Hospital fifty-three had visible papillæ. In order to determine the proportion of cases in which the papillæ were visible normally a colleague at St. Mark's had examined a series of patients who attended the hospital, and twelve out of fifty had visible papillæ. In these cases of hypertrophied papillæ cure could be brought about by cauterization.

Mr. ASLETT BALDWIN

said that when no local cause for pruritus could be found, the bowel above should be examined with the sigmoidoscope. A catarrhal condition would often be found to exist. This led to a frequent slight leakage of mucus and microbes from the anus, and this caused the constant dampness and consecutive dermatitis which was often present. Great relief was afforded by daily irrigation of the bowel with common salt, sanitas or boric acid solution, the patient ascertaining by trial which suited him best. The anus should frequently be bathed with boric acid lotion and then dried. Locally, "hazeline cream" was found very useful; also—provided the part was not too tender—painting with tincture of iodine or tinct. benzoin co., the buttocks being held apart till the application had become dry.

Dr. W. M. FELDMAN

agreed with the last speaker with regard to the importance of a thorough examination of the inside of the rectum, as some of the most difficult cases of pruritus ani were accompanied by a considerable oozing from the rectum somewhat analogous to the leucorrhœa occurring in women. Unfortunately the rectoscope did not always reveal any abnormal condition of the mucous membrane of the rectum.

Neither Mr. Lockhart-Mummery nor the subsequent speakers had mentioned the importance of having a good opening of the bowels before going to bed, as in his experience that very often made all the difference between the patient's having a good or disturbed night.

As regards Sir Charles Gordon-Watson's remark about heredity being a factor in the ætiology of this condition, Dr. Feldman agreed that occasionally one met with a case in which a similar condition occurred in another one or more members of the family, but whether the occurrence of the condition was a consequence or a coincidence it was not quite easy to say. For instance he knew of one case in which the patient's father was afflicted with the same condition in a milder form and his paternal grandmother was a sufferer from pruritus vulvæ, but on the other hand he also had a patient with pruritus ani whose brother-in-law was suffering from the same thing. If in this case the brother-in-law had been related to the patient by consanguinity rather than by affinity one might have been tempted to attribute the trouble to some hereditary factor.

Dr. Feldman asked whether the condition was common in women; in his (Dr. Feldman's) practice there had been fairly numerous cases in men, but not one in a woman. Dr. Feldman also asked for any explanation as to why the condition was more troublesome at night.

Mr. FRANK COKE (a Visitor to the Section)

said his interest in pruritus ani arose from the report of two cases in the American literature which had been proved by the skin tests to be due to sensitization to food. The hereditary and paroxysmal nature, the nightly exacerbations, the excess of moisture, the muscular spasm, the hypertrophied and sensitive papillæ, the cure by destruction of these with the cautery and the variety of other treatments, each of which could claim cures, all showed a marked similarity to the other results of food sensitization, namely, asthma, eczemas and rhinorrhœa.

The PRESIDENT

differentiated between pruritus due to a local condition affecting the peri-anal region and that which was part of another disease. A particular cause was dampness of the anal region due to hyperactivity of the skin in that region. He thought that hypertrophied anal papillæ were present in the majority of cases of pruritus ani. Their most productive cause was rectal constipation, producing a collection of fæcal material where it ought not to be. In the anal papillæ there was a profusion of nerve terminals in which was situated a special rectal sense to guard against the involuntary discharge of fæces. Rectal constipation produced a muscular spasm so that the rectum was not completely emptied. The treatment he advocated was to keep the anal region dry and to ensure the emptying of the rectum at night by the introduction of half-a-pint of water at a temperature of from 70° to 80° F. He was sure that 80 per cent. of the cases could be cured by dryness, cleanliness, relieving constipation and removing any obvious cause. Another 10 per cent. might require other treatment such as zinc ionization (which was extremely good), or X-rays. The remaining 10 per cent. were patients with neurotic tendencies who would defeat all efforts and permanently remind us of the limitations in medicine and surgery.

Section of Surgery.

SUB-SECTION OF PROCTOLOGY.

President—Mr. W. Ernest Miles, F.R.C.S.

INFORMAL DISCUSSION.[1]

The President

opened an informal discussion. The idea, he said, was a good one, and enabled members to compare views. He would like to bring forward for discussion two subjects :—

(I) Abscess and Sinus over the Lower Part of the Sacrum.

This was an uncommon condition. He saw a case last week of an abscess to the left of the upper part of the internatal cleft—nearly all of it had been to the left of the internatal line. The tracks as a rule extended up and down, but rarely had a connexion with the rectum ; one entered the sacro-sciatic foramen and opened into an ischio-rectal abscess.

Ætiology.—Some might be due to necrosis, but he had never seen a case in which carious bone had been the cause, although he had seen over thirty cases. The tracks might burrow beneath the ligamentous tissues.

Mr. Swinford Edwards

thought these cases were due to trauma with resulting infection. He agreed with the President that the tracks were never connected with the rectum. He advised free drainage and laying them into flat wounds. He advised leaving bone alone, as it was rarely the cause of the trouble.

Sir Charles Gordon Watson

asked whether some cases might be due to suppurating dermoids. He said he had found some abscesses containing hair.

Mr. Webb

said he had seen one case at the Middlesex Hospital which proved to be a dermoid.

Mr. Lockhart-Mummery

said that many of these formations were lined with epithelium and were dermoids, and Sir John Bland-Sutton had described these in his book. They were dermoids lying superficially to the coccyx. He advised their excision.

The President

believed that there were two distinct conditions, one due to infection following trauma, the other due to dermoids. The antecedent trauma might have occurred a long time before infection.

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[1] At a meeting of the Sub-section, held May 11, 1921.

Mr. JOCELYN SWAN

said that some cases might be due to tubercle.

All the speakers agreed that every specimen from cases of this description should be sectioned, and Sir GORDON WATSON proposed that the Hon. Secretary, Mr. GRAEME ANDERSON, should write to all members of the Subsection asking them to notify him of such cases, and to obtain sections if possible.

The second subject brought forward for discussion by the PRESIDENT was :—

(II) Adenomyoma of the Rectum.

Adenomyomata were locally malignant: tubular glands permeating a fibromuscular stroma ; a single layer of cylindrical epithelium.

In one case, in the middle of the pelvic colon, a whipcord stricture was found to be adherent to the fundus uteri. This was thought to be a carcinoma, but on section it proved to be an adenomyoma.

In a second case there was an adenomyoma of the uterus with the left utero-sacral ligament much thickened. The ligament was removed and sectioned and showed infiltration with adenomyoma, and in time he believed that the first part of the pelvic colon would have been involved.

He described a third case in which an adenomyoma of the cervix had involved the rectum and hæmorrhage had occurred *per rectum* during menstruation. A section showed adenomyomatous tissue in the anterior rectal wall.

Leitch believed that the tumour-cells in these cases were migratory and came from the uterus. Lockyer had reported a case in which he had removed the uterus and segment of bowel and had left a permanent colostomy. The possibility of the occurrence of adenomyoma should be borne in mind in all instances of supposed rectal carcinomata. Only about eleven such cases had been recorded.

Section of Surgery.

President—Mr. Walter G. Spencer, O.B.E., M.S.

Cardiac Massage.[1]

By A. G. Levy, M.D., M.R.C.P.

The principles underlying massage of the heart are very much the same for whatever condition it is applied. I propose first to state these general principles, and later to discuss the employment of massage in chloroform syncope, a form of syncope with which I am most familiar from an experimental point of view, and a form which is, I think, of more interest to the surgeon than any other.

The conclusions at which I have arrived are mainly the outcome of a recent investigation, and whilst I have some things to say which are new, a good deal is not new but is in agreement with and serves to confirm the opinion of others.

J. A. Gunn [4] has recently published a paper in which he lays down certain physiological principles for guidance in performing massage, and whilst I accord with much that he has written, his paper requires expansion, for he deals with one form of chloroform syncope only, viz., that from overdosage, whereas primary cardiac syncope is the condition which calls most urgently for the application of this method of resuscitation.

I think that the small number of cases in which cardiac massage has been practised with a successful result are sufficiently well known to excuse further comment upon them, but I am sure that the large number of the unsuccessful attempts is unappreciated; they are in fact almost sufficiently numerous to bring cardiac massage into disrepute. This is not as it should be, and I am therefore putting forward how consistently successful results are obtained in animals, and I shall give my reasons for believing that similar results can be obtained in man.

The sole function of cardiac massage, as I maintain in common with others, is to create an artificial circulation; to perfuse the lungs, and to supply the heart and central nervous tissues with oxygenated blood in order to preserve their function. This view has been brought forcibly home to me in my special work.

The term "massage" is a misnomer; it is not massage of the muscular tissue of the heart, which is required, but a rhythmical compression of the heart efficient in expelling with fair force the contents of both ventricles; the right ventricle must be compressed as well as the left, and I have not found my experimental results to be consistently satisfactory unless this point receives careful attention. Obviously a good supply of oxygenated blood to the left ventricle can only be obtained by emptying the right.

In the human heart, therefore, the hand must have ready access to the right ventricle, and this is one of the points in surgical technique which tends to turn the scale between success and failure.

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[1] At a meeting of the Section, held June 1 1921.

I may digress for a moment to a point of more academic interest. Gunn [4] maintains that massage also acts as a mechanical stimulus to the heart beat; it is, however, difficult to see how this can be or to agree that sufficient reason has been given in support of this view. Personally I believe massage is deleterious to the heart beat and I think Gunn and Martin's [5] own experiments may be interpreted as bearing out this point of view; the heart beat is most certainly not initiated in cases of ventricular fibrillation (*see* fig. 2) by mechanical stimulus, and I think this theory should be entirely disregarded in considering practical methods.

Surgical Technique.—The technique of obtaining proper access to the heart and compressing it is evidently of great importance; direct access to the heart appears to me to be essential.

In a number of recorded cases of the practice of massage the heart has been exposed by resecting the costal cartilages and opening the pericardium, but this method has been attended with a single success only. It is a somewhat severe operation, and the delay incurred is a serious disadvantage.

The subdiaphragmatic mode of approach has nearly all the recorded successes to its credit, but I believe likewise a very large number of failures. It can rarely be entirely satisfactory. Bost and Neve [1] say that compression of the heart in this way is possible though difficult in the child, but in the adult it can rarely be effected, as only the cardiac apex can be reached, and this tends to slip upwards. Further they say that it is possible to obtain direct access to the heart inside the pericardium by an incision into the base of it from below the diaphragm; the left lobe of the liver and the stomach are, however, liable to get in the way in this operation: there is a risk of injuring the musculo-phrenic artery, and there is considerable difficulty in inserting sutures in the diaphragm and finally closing the incision. Bost and Neve [1] have therefore devised another method of obtaining direct access, which is briefly as follows: An abdominal incision is made and through this the attachments of the diaphragm to the left costal margin are cut for 2 in. The right hand is inserted into the left pleural cavity and the heart grasped outside the pericardium. During massage the parts are pressed around the right wrist to prevent air entering the pleural cavity. This method appears to me to satisfy most nearly the required conditions. Bost and Neve [1] obtained a success with it in a case in which the subdiaphragmatic method had previously failed, and Coleman [2] has recently narrated a somewhat similar experience.

The Performance of Artificial Respiration.—Success as a result of cardiac massage is almost out of the question without artificial respiration, but there is, as a fact, abundant evidence that its performance has been frequently neglected.

In man, judging by clinical records, as in cats, there is frequently a strong tendency to the persistence of the respirations after primary cardiac failure, and no doubt cardiac massage will assist to maintain them if performed soon enough. Such efforts can, however, only be fitful and are quite inefficient for the purpose in view as a general rule, although it would appear that recovery by massage has occurred in a few instances without artificial respiratory assistance.

Possibly artificial respiration by Silvester's method is sufficient when there is no opening into the pleural cavity, if it can be done without interference with the proper performance of massage. In the case of an operation for direct access to the heart perflation of the lungs is without question the right method to adopt; it obviates the risk of the production of pneumothorax and provides for the full inflation of the lungs when the hand is in the left pleural cavity.

Intubation of the larynx can easily be performed on an individual in the flaccid condition following cardiac syncope, when the initial asphyxial spasm, if any, has passed off, and the lungs can be readily blown up through the tube by the lung power of another person. Perflation of the lungs by means of the apparatus employed for the intratracheal method of administering an anæsthetic should likewise be effective; a steady stream of oxygen passed direct from a cylinder through an intratracheal tube would serve exceedingly well, provided of course the force of the blast be carefully controlled. A pair of bellows constitutes a simple apparatus for performing intermittent perflation. Even mouth to mouth perflation may be practised in an emergency, but one or other method must be employed in an efficient manner in conjunction with intrathoracic massage if cardiac massage is to be made a practical success.

I agree with Gunn as to the importance of a proper mechanical device being available for the purpose of artificial respiration; there used to be an apparatus of this kind called a lung motor on the market, but I have no personal experience of its employment. It has been urged that the rigidity of the human thoracic cage tells against intermittent perflation, but the pliability of the diaphragm allows sufficient room for pulmonary expansion.

W. E. Fisher [3] has practised with success a method of combined massage and artificial respiration: by a series of thrusts with the fingers under the diaphragm he at the same time compressed the heart and expelled air from the thorax. Such a method as this can only be regarded as tentative, and not likely to have a large measure of success; I am convinced that both surgeon and anæsthetist must be absolutely thorough in their methods if they are to justify the performance of massage.[1]

The Method of Applying Cardiac Compression.—I have tested the effect of varying the rate of compression, and do not myself regard this as a matter of much importance. It is necessary to maintain sufficient circulation pressure in the arteries, so I do not think the rate should be much less than that of the natural beat. The rate of compression bears no relation to that of the spontaneous beat on recovery.

Gunn and Martin [5] have found that in the overdosed heart a spontaneous beat develops more readily after a pause in the massage, and they recommend that after a time massage should be intermitted by short pauses. I have independently found that recovery after primary cardiac failure is influenced similarly, a matter to which I will refer again later. The interruption of massage is evidently a point of considerable importance.

The Limit of the Interval between the Occurrence of Syncope and the Commencement of Massage.—This point appears to be fairly well decided. The limit is not conditioned by any cardiac consideration, at least not mainly, for the heart possesses remarkable powers of recuperation after prolonged periods of suspended circulation. The limit is a quite narrow one and is set by the length of time that the nerve centres can stand deprivation of blood; if this interval is too long, severe nervous symptoms supervene on restoration of the circulation, such as tetany, rigidity, screaming, incontinence of urine, and signs of severe cerebral irritation, and these generally terminate fatally.

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[1] I presume the anæsthetist devotes his attention to the pulmonary ventilation.

Evidently A. E. Russell's [11] limit of five minutes is a safe one, and is now generally accepted, but the case need not be regarded as absolutely hopeless after a longer interval; in Mollison's [9] case it was thirteen minutes, but the patient only recovered after prolonged and serious cerebral symptoms had occurred. This time limit is within that in which intravascular clotting can occur, so that this matter does not require special consideration.

Posture.—Partial inversion is no doubt of benefit in assisting the cerebral circulation, and the filling of the heart chambers. There is no experimental evidence to show that it assists recovery in any other way.

CHLOROFORM SYNCOPE.

The foregoing principles have a general application to cardiac massage under any circumstances. In chloroform narcosis there are two principal forms of syncope which require some separate consideration.

(1) *Syncope from Overdosage.*—In this form of syncope both the heart and respiratory centre are affected by the excess of chloroform, but the respiration fails first, and the heart subsequently, partly from the effect of the chloroform and partly from lack of oxygen. The heart's action is never totally suppressed by an overdose and it continues to beat, faintly it is true, but yet without doubt sufficiently to maintain a measure of pulmonary and coronary circulation; artificial respiration can thus restore the heart beat, first by supplying much needed oxygen, and secondly by causing exhalation of the excess of chloroform. It is my personal opinion that recovery can always be effected by artificial respiration alone when promptly applied, as probably it always is, but I recognize that if it be neglected the heart becomes totally asphyxiated and incapacitated and may not then be amenable to this treatment. In such an exceptional circumstance cardiac massage would be called for.

The adequacy of massage to restore the beat of the overdosed heart has been fully proved; my personal experience in experiments on cats has been a rapid success in all cases, even in hearts artificially overdosed to the complete extinction of the ventricular beat.

The heart recovers from an overdose in a characteristic fashion. The beat is at first very feeble and may require further massage to improve it. Thenceforth improvement in both beat and blood pressure is gradual and progressive, consistent with the view that the heart gains in strength as the blood excretes its chloroform (fig. 1).

Gunn [4] recommends washing adrenalin into the heart through the jugular vein before commencing massage, but it cannot enter the coronary circulation unless the heart is beating, when it is not wanted, or until the commencement of massage, which succeeds without it. In my own experimental experience adrenalin has no beneficial effect upon a heart which has been overdosed with chloroform to the extinction of its function, so that it does not appear to me that the risky combination of adrenalin and chloroform is justified by any theoretical consideration. If the blood-pressure is low following recovery, then pituitrin should be injected, not adrenalin, for the latter is dangerous to the heart which has thrown off its excess of chloroform. I can confirm Gunn and Martin's [5] observation that although the action of the vasoconstrictor agent be temporary, the effect in such circumstances tends to be a permanent rise of pressure.

(2) *Primary Cardiac Syncope.*—In this form of syncope the respiratory centre is not depressed by the chloroform and the respirations continue for a short period after the stoppage of the heart, but the respirations fail like-

wise shortly afterwards owing to cessation of the circulation. Neither is the heart depressed by the chloroform; it fails quite suddenly from the onset of ventricular fibrillation in the course of full activity. Sometimes the respirations are exaggerated immediately before they finally cease, sometimes there is a spasm of the whole body; sudden pallor and extreme dilatation of the pupils also help to identify this form of syncope.

Ventricular fibrillation has generally been regarded as necessarily fatal, but this is by no means the case; that recovery may occur in man is proved by the electrocardiographic record obtained by Robinson and Bredeck [10], and there is indeed in my opinion clinical evidence that spontaneous recovery is more common in man than a fatal termination.

Three cases of serious syncope noted by Seymour Jones [6] following the injection of adrenalin under chloroform were certainly due to ventricular fibrillation, yet they all recovered without treatment; a number of reports of spontaneous recovery from primary cardiac syncope in chloroform anæsthesia are found in the pages of the Report of the Anæsthetic Committee of the British Medical Association, and in these instances there can be little doubt fibrillation had occurred.

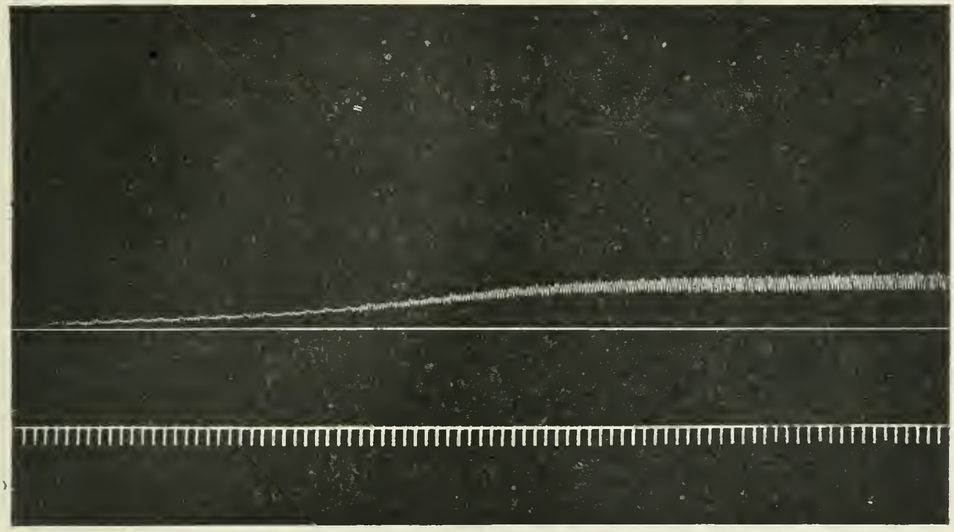

FIG. 1 (full size).—Blood-pressure curve from an experiment upon a cat. Hurtlé manometer. Time marked in seconds. The heart had been overdosed with chloroform to extinction of the beat. The heart beat was restored by massage and artificial respiration, and the tracing shows the characteristic gradual improvement of beat and blood-pressure which occurs after an overdose.

I am laying stress upon this tendency towards spontaneous recovery from fibrillation in man, because it is correlated with success in the practice of cardiac massage, massage being merely a means of saving the heart from asphyxia, and affording it a prolonged opportunity of exerting its natural tendency to recover spontaneously. In dogs there is little of this tendency, and attempts at resuscitation by massage generally terminate in failure. In cats on the other hand there is a conspicuous tendency towards spontaneous recovery, and in these animals I have found cardiac massage consistently successful. I therefore class man in the same category as the cat, in respect of the successful issue of massage.

In cats spontaneous recovery always occurs whilst the heart is still vigorous and the fibrillary movements active, that is within the first one and a quarter minutes from the moment of syncope; it cannot occur later when the heart has become asphyxiated. On perfusing the heart with oxygenated blood by massage with artificial respiration the active fibrillation is sustained until sooner or later, provided massage is continued sufficiently long, the fibrillary movements are replaced by the normal sequential beat.[1]

The practical lesson is obvious; not more than two minutes should be allowed for the chance of spontaneous recovery following primary cardiac syncope in man, and thereafter cardiac massage should be proceeded with without hesitation.

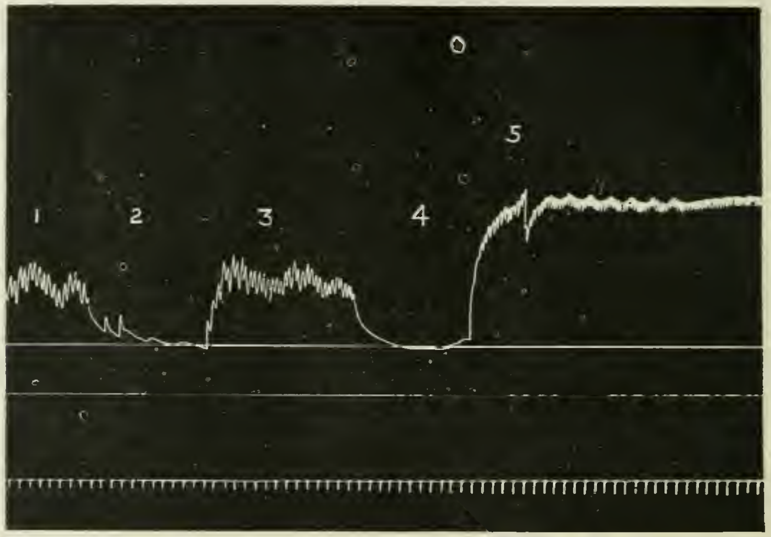

FIG. 2 (full size).—Blood-pressure curve from an experiment on a cat. Hurtlé manometer. Time marked in seconds. Resuscitation of the fibrillating ventricles by cardiac massage combined with artificial respiration. The tracing shows two periods of massage, 1 and 3, and two pauses, 2 and 4. The heart recovers during a pause. The recovery from fibrillation, 5, is characteristically rapid, and contrasts vividly with the gradual recovery after overdose.

If recovery is not effected within the first five minutes of massage, this should be intermitted by a pause of about fifteen seconds, later extended to forty-five seconds, and this procedure may be found successful either during the pause or on resumption of massage. A pause appears to rest the heart from the depressing influence of manipulation, for it results in increased fibrillary activity. An illustration of this event is shown in fig. 2; incidentally such an experiment shows how mechanical stimulus plays no part in the resuscitation of the normal beat.

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[1] Recovery from fibrillation is not merely a recovery from inactivity, as it is in the case of overdosage. The normal beat is not superposed on fibrillation, and the latter must cease before recovery can take place; there is a momentary phase of inactivity interposed.

The recovery from fibrillation is sudden and characteristic; the first beats are sufficiently powerful to cause the blood-pressure to mount up rapidly (fig. 2), for the heart has not been depressed by an excess of chloroform.[1]

Sometimes a temporary cessation of fibrillation occurs within the first few minutes of onset, but the heart cannot beat because it is asphyxiated and fibrillation is soon resumed. If such a period happen to be hit upon when one is commencing massage, recovery is easy and rapid, but the beats are first feeble and gain strength slowly, for it is a recovery from simple asphyxia.

Apart from this happy chance the length of interval between syncope and the commencement of massage is not of great importance, at least up to a limit of fifteen minutes. The duration of massage is fortuitous; it varied from one up to forty-eight minutes in a series of twenty-nine cats upon which I experimented. The following table shows my results *in extenso*. Every case had a successful issue, so that the absolute efficiency of massage for fibrillation in cats is remarkable.

Interval from moment of syncope to commencement of massage	Duration of massage before ventricular beat returned
2 minutes	19 minutes, 30 seconds; 20 seconds*; 1 minute; 10 seconds*; 1 minute*; 9 minutes, 35 seconds; 1 minute*; 4 minutes; 12 minutes, 30 seconds
2 minutes, 30 seconds	2 minutes; 4 minutes, 30 seconds; 9 minutes
3 minutes	16 minutes; 5 minutes, 30 seconds; 20 seconds* 2 minutes, 50 seconds
4 minutes	3 minutes
5 minutes	30 seconds*
7 minutes	48 minutes
8 minutes	22 minutes, 25 seconds; 6 minutes, 10 seconds
9 minutes	23 minutes
10 minutes	3 minutes, 15 seconds; 5 minutes, 40 seconds
11 minutes	4 minutes
12 minutes	8 minutes
13 minutes	4 minutes, 10 seconds; 7 minutes
15 minutes	24 minutes, 30 seconds

* In those experiments marked by asterisks fibrillation was in abeyance when massage was commenced.

The blood-pressure on recovery from fibrillation is nearly always satisfactory; should it be unsatisfactory an injection of pituitrin will improve it very much.

McWilliam [8] tested the action of adrenalin and a number of other drugs upon the fibrillating ventricles; he used them in conjunction with massage and obtained successful results. I have repeated most of these experiments, but in my experience the results of massage alone are equally good, and I have so far been unable to convince myself that any of the drugs are of real service. Further research is desirable upon the subject, but for the present drugs are better left alone, for the drug that will stop fibrillation is yet to be found.

It is for the treatment of primary cardiac syncope from ventricular fibrillation that cardiac massage finds its most urgent application. If a patient fails to recover spontaneously from fibrillation within two minutes massage becomes imperative, for there is no other remedy. I think I may claim to have demonstrated the effectiveness of this remedy; the treatment of ventricular fibrillation by this method in cats has been shown to be consistently successful and I believe similar results can be obtained in man. It must be admitted however that the conditions are not so favourable in man. In animal experiments the chest is laid open and the heart made thoroughly accessible ; it can be compressed by the fingers without undue fatigue, the efficiency of massage can be judged by inspecting the colour of the left auricle, the lungs are seen expanding and the efficiency of the artificial respiration can be gauged, and the nature of the fibrillary movements can be inspected. In man there must be some difficulty in getting at the heart and efficiently embracing the ventricles in the grasp, and fatigue of the operator's hand is an element which is not negligible in a prolonged case. The proposition in man seems to me a somewhat different one and occasional failures must be expected, but with a proper knowledge of the principles involved and their careful application very much better results may, I am persuaded, be obtained in cases of massage than has hitherto been the case.

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[1] Fibrillation does not occur in full chloroform anæsthesia.

RULES FOR THE PERFORMANCE OF CARDIAC MASSAGE IN CHLOROFORM SYNCOPE.

(*a*) In syncope from overdosage. Partial inversion and immediate artificial respiration by Silvester's method. If recovery does not occur within three minutes, artificial respiration alone is not likely to avail. Proceed after three minutes to perform intrathoracic massage with perflation of the lungs.

(*b*) In syncope from primary cardiac syncope. Partial inversion for two minutes (with artificial respiration if the diagnosis is not quite certain). If spontaneous recovery does not occur within two minutes, proceed at once to intrathoracic massage, with perflation of the lungs.

(*c*) In the interest of the nerve centres cardiac massage should be commenced within five minutes of syncope.

(*d*) Success depends upon proper access to, and the efficient compression of both ventricles, and an efficient system of artificial respiration.

(*e*) If continued rhythmic compression is not successful in five minutes, it should be intermitted for periods of up to forty-five seconds' duration.

(*f*) Massage should be continued, if necessary, up to one hour's duration, before abandoning the case.

(*g*) It is advisable to rely throughout on massage alone and discard the use of drugs.

(*h*) If the circulation is feeble after recovery, an intravenous injection of pituitrin is desirable.

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Section of Surgery.

SUB-SECTION OF ORTHOPÆDICS.[1]

President of Sub-section — Mr. E. Laming Evans, C.B.E., F.R.C.S.

DISCUSSION ON BONE-GRAFTING.

Mr. E. W. Hey Groves

reported the following four cases illustrating special points in bone-grafting:—

Case I.—R. D., aged 40. Gunshot wound, right arm, 1917. Gap fracture of middle of shaft of radius had been repaired by means of autogenous tibial graft shaped like a cricket bail. Condition three years after showed strong bone of same thickness as normal radius.

Case II.—D. C., aged 32. Gunshot wound of right forearm, loss of about 3 in. of lower part of shaft, articular end being preserved. An attempt at restitution had been made, first by loosely placing a small piece of tibia in the gap and then by adding a steel plate. Both these methods had failed. After removal of ragged bone ends and all scar tissue a stout tibial graft had been placed in position with ample intramedullary fixation. Result two years later showed perfect functional and structural unity of the graft with its bed.

Case III.—R. T., aged 39. Gunshot wound of humerus complicated by gap fracture of middle of shaft, ankylosis of elbow and musculo-spiral paralysis. Nerve had been successfully sutured in 1919. In 1920 fracture had been treated by dead bone-graft. Piece of beef bone 6 in. by $\frac{3}{4}$ in. by $\frac{1}{2}$ in. previously prepared had been driven into proximal fragment and slipped into distal fragment after splitting latter. Condition after fifteen months showed firm union of humerus with consolidation round central shaft.

Case IV.—G. P., aged 11. Fibrocystic disease of left humerus. Between 1916 and 1920 boy had four times fractured the arm, the humerus of which showed cystic degeneration in middle of shaft for distance of 3 in. On January 14, 1920, he had been treated by excision of diseased area followed by insertion of double beef-bone graft, prepared by making two pieces of bone each 6 in. long by $\frac{3}{4}$ in. by $\frac{1}{2}$ in., and overlapping each other for 3 in. These had been bolted together so as to form a graft $\frac{3}{4}$ in. by 1 in. thick in the central part, with projecting pegs 3 in. by $\frac{3}{4}$ in. by $\frac{1}{2}$ in. The graft had been taken to pieces and each end driven into one fragment of humerus above and below the 3 in. gap after subperiosteal resection of diseased area. The two portions of graft had been bolted together. Patient had made uninterrupted recovery, and X-rays taken at three-monthly intervals demonstrated that the bone had been rapidly re-formed round central graft, and that sixteen months after operation the latter was still a solid central strut, showing certain amount of absorption. The contour and general solidity of the humerus was normal and function of limb was perfect.

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[1] At a meeting of the Sub-section, held May 3, 1921.

Mr. M. Fitzmaurice Kelly,

reported on a case of flail shoulder treated by bone-grafting. W. J. D., aged 22, had been wounded on April 25, 1918, in right shoulder, and taken prisoner. Head and portion of shaft of humerus had been removed, total deficiency being 3½ in. When seen, arm was quite useless and could not be raised, but there was no nerve lesion and movements of elbow, wrist, and fingers were good. After preliminary excision of scar, operation for arthrodesis had been performed on April 21. Upper end of humerus had been easily cleared and about ¾ in. of sclerosed bone cut away. Glenoid cavity had been defined with difficulty, and fibrous tissue and remains of cartilage removed, exposing cancellous bone in its whole extent. Glenoid had been then tunnelled with a gouge upwards and inwards into the supraspinous fossa, the angle being about 70° abduction and 30° flexion. Five inches of middle of left fibula had been taken as graft, and anterior borders removed, this rendering graft roughly cylindrical, and opening up medullary cavity throughout. Graft had then been wedged into medulla of humerus for about half its length, and other end through glenoid cavity, humerus being brought within about ½ in. of lower end of glenoid. Arm and shoulder had been fixed in plaster.

Skiagrams were exhibited showing the condition before operation, and the graft in position, taken through the plaster.

A further report of progress would be given at a future meeting.

Mr. D. McCrae Aitken

showed a pensioner, H., wounded April, 1917. Bone-graft, February, 1919, at Middlesex Hospital. Referred to Shepherd's Bush Hospital, May, 1920. X-ray, June 18, 1920, showed disunion both ends of graft. At this time arm had been more pronated than now.

Treatment: Forearm supinated and pulled out and fixed in plaster in most supine position possible. Kept in plaster.

Intention of treatment: To improve alignment prior to further operative treatment.

X-ray, taken April 16, 1920, showed that the bone-graft had reunited.

The further question of shortening ulna had now arisen.

Mr. C. Max Page

said that fracture of bone-grafts occurred all too frequently; in his experience the fracture did not necessarily take place at the level at which the graft was attached to the host bone but not uncommonly occurred in the free part. Inadequate external fixation was responsible for many of these accidents; he believed that prolonged fixation by means of plaster of Paris splints was the only method which could be relied upon. It was clear that in the first instance a graft of substantial strength should be employed and that it should be firmly fixed at both ends; but there were periods in the process of its absorption and conversion into living bone during which the graft was weaker than when first inserted. It was not possible exactly to define the period during which external support was necessary, but it might extend beyond a year and the time at which it could be dispensed with must be determined by an examination of the X-ray of each individual case. He advocated the use of plaster of Paris as the only method by which close fixation of the bone could be obtained; the splint could be efficiently applied without interfering with the use of the hand in the upper extremity, and in the case of the lower extremity the appliance could be an ambulatory one, allowing a fair amount of weight to pass through the long axis of the bone whilst protecting it from undue lateral strain.

In regard to the use of intramedullary pegging as a method of fixing bone-graft he could not agree with the distrust of the procedure that had been expressed. He considered that for a large proportion of cases it was the method of choice on account of the close coaptation which it gave between the graft and the host bone.

PROCEEDINGS

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SESSION 1920-21

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Section of Therapeutics and Pharmacology.

President—Dr. H. H. DALE, C.B.E., M.D., F.R.S.

The Significance of the Jaw-neck Syndrome in the Rheumatic Group of Diseases.[1]

By ARTHUR STANLEY HERBERT, O.B.E., M.D., B.S.Lond.

(*Late Government Balneologist to the Dominion of New Zealand.*)

(ABSTRACT.)

IT is well known that involvement of the temporo-maxillary joint is common in certain forms of arthritis and uncommon in others, but the great importance of this point as a differentiating symptom in the diagnosis, and consequently in the treatment, of the so-called rheumatic diseases is insufficiently recognized. The whole medley of diseases vaguely classed under the heading of "rheumatic" or "gouty" can be divided sharply into two groups: (A) those in which the temporo-maxillary joint is involved, and (B) those in which it is not.

The importance of this division lies in the fact that, if in any case we find this joint affected, we can conclude that we are dealing with a condition due to some bacterial toxin, and say definitely that it is *not* one of gout, however closely that disease may be simulated. Could we define our conception of rheumatism with certainty and limit the application of the term to cover rheumatic fever and chronic cases directly connected with it, I would extend the axiom, and say that we can definitely exclude both gout and rheumatism. For while acute rheumatism is generally conceded to be due to microbic invasion, yet the toxin does not appear to select this particular joint.

A rheumatic or gouty person may, of course, have his jaws affected, for he is no more and no less immune than other people to the various toxins which affect the joints, but the jaw lesion is due to some secondary or superadded infection, and the underlying cause must be sought in gonorrhœa, rheumatoid arthritis, dysentery, oral sepsis, &c.

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[1] At a meeting of the Section, held October 19, 1920.

One other and confirmatory symptom group shares in this pathognomonic import, and that consists in pain, stiffness, and sometimes grating, in the back of the neck just below the occiput. (The pathology of this condition was discussed in the light of the experimental work of Nathan [1].) This symptom group is not met with in pure rheumatism or gout; it is nearly always coincident with the jaw symptom, and like it is always a sign of some other form of arthritis. The syndrome has been spoken of as pathognomonic of rheumatoid arthritis. This however is only a half-truth. While it certainly is present in the great majority of cases of rheumatoid arthritis, it is pathognomonic, not of that disease, but of a whole group of infective and toxic conditions of which rheumatoid arthritis is but a member and a type. I would lay it down as a definite law that in *gout and true rheumatism the syndrome is always absent, and conversely that in the toxic and infective group it is nearly always present.*

The above statements may appear somewhat sweeping and dogmatic, and there must be exceptions to this rule, but the exceptions are not, I think, numerous. Thus, while the syndrome is never present in gout, and I believe never in rheumatism, it is occasionally absent in the toxic group, and it may be incomplete, the jaw symptoms being the sign generally lacking. Again the syndrome may be more frequently absent in some countries and climates than in others, a phenomenon quite explicable, for variations in the strains of micro-organisms occur under such conditions. (The incidence of the syndrome in gonorrhœal, post-dysenteric, and rheumatoid arthritis, also in eleven cases of arthritis consequent on acute specific fevers, and in two apparently due to hyperthyroidism, was here discussed.)

Before proceeding to classify the rheumatic group of diseases in the light of this syndrome, a clear definition of our terms is necessary; for in this branch of medicine there is a hopeless confusion of nomenclature, and the same term may connote two utterly different diseases in the minds of two wholly competent observers; I refer more especially to the use of the terms "rheumatism" and "rheumatoid arthritis."

At present we are confronted with the fact that the word rheumatism is used in conjunction with such an adjective as gonorrhœal, and if we confine the use of the word to its strict meaning we must invent a new adjective, for the term gonorrheal *arthritis* by no means covers the ground. Used broadly in its loose sense "rheumatism" would seem to cover all the cases of chronic arthritis that do not tend habitually to suppuration, together with fibrositis and certain forms of neuritis and iritis, and in that loose sense it is employed in the following tables. (A definition of the nomenclature adopted in the tables here followed: the more important points are selected as under.)

Gonorrhœal "rheumatism" is interesting because, while a well-defined and well-recognized entity, it constitutes a prototype of the whole Group B. The disease may be a toxic arthritis, or the joints may be directly infected and show the gonococcus in pure culture, or again there may be a secondary infection with other organisms—e.g., influenzal. The clinical picture is almost too familiar for comment, but I draw attention to the following points: The jaw-neck syndrome is nearly always present at some stage of the disease. There is frequently in acute cases a characteristic careworn facies. There is often a bony spur from the os calcis into the plantar fascia, which makes a striking X-ray picture, and there is a tendency to atrophy of the interphalangeal articular cartilages out of proportion to the apparent severity of the local arthritis, which is suggestive, though of course not pathognomonic. In view of the not infrequent secondary infections, it is important to remember that the condition may be lit up by some other infection twenty years after a wholly forgotten and insignificant gonorrhœa, followed by an equally mild and ignored "rheumatism." The clinical picture of the other members of the group is practically identical with that of gonorrhœal rheumatism, with the exception of the plantar spur, which I have never yet encountered in other forms of toxic arthritis.

Toxic Arthritis or Rheumatism.—In this condition the joint trouble is set up by the toxin evolved from an infected focus, and there is no invasion of the joints by micro-organisms. The toxin may act as a direct poison on the joint, or by way of the central nervous system, or possibly in some cases through the endocrine glands—e.g., the thyroid gland.

Rheumatoid Arthritis.—Whether this disease is a separate entity or whether it is merely part of the foregoing group is still a matter of dispute. The completeness of the clinical picture leads me personally to consider it a specific disease due to the toxin of a specific micro-organism. Like the rest of the toxic group it shows the jaw-neck syndrome, but it is generally distinguished by the more pronounced symmetry of the articular and peri-articular lesions, as evidenced especially in the first interphalangeal joints of the ring and middle fingers; by the more marked trophic changes of the bones, as evidenced in a skiagram by the rarefaction of the phalanges in the neighbourhood of affected joints; by neuro-trophic phenomena, such as sweating palms and bronzed skin; by persistent tachycardia; and by its predilection for women.

(?) *Thyroid Arthritis.*—Clinically indistinguishable from ordinary toxic arthritis. (The connexion between Graves' disease and rheumatoid arthritis was discussed, and two cases of arthritis apparently due to hyperthyroidism were detailed. These two cases cleared up under measures directed solely to treatment of the thyroid condition.)

Osteo-arthritis is wholly dissimilar from rheumatoid arthritis, and I submit that, so far as the bony changes are concerned, it is not really a disease entity at all, but rather an end-process and final stage of many diseases, an effort of Nature to repair the ravages of disease or injury. It was pointed out by Lane [12] that the amount of bone formation, represented by eburnation and bossing, bears a direct relation to the vitality of the osseous system. Thus in Charcot's disease these reparative changes are practically absent, in rheumatoid arthritis scanty, in gout or traumatic arthritis very abundant.

SUGGESTED CLASSIFICATION OF THE "RHEUMATIC" GROUP OF ARTHRITIC DISEASES.

Group A. Jaw-neck syndrome absent	(1) Gout ...	Acute Chronic	
	(2) Rheumatism	Acute Chronic	
Group B. Jaw-neck syndrome present The toxic and infective group	(3) Gonorrhœal arthritis or rheumatism		Ending all in *Group D.* Osteo-arthritis
	(4) Dysenteric ,, ,,		
	(5) Toxic ,, ,,		
	(6) Rheumatoid ,,		
	(7) Arthritis following acute specific fevers, e.g.—	Measles Scarlet fever Enteric Mumps Influenza	
	(8) ? Thyroid arthritis		
Group C. (Not rheumatic)	Traumatic arthritis		

Treatment.—The syndrome enables us to make a provisional classification in chronic arthritis, and in the present state of our knowledge any classification is necessarily provisional. By so doing, it very materially aids in accurate diagnosis, an essential preliminary to satisfactory treatment. The essence of treatment is first, if possible, to remove the cause, and then, if necessary, to mitigate its effects, to relieve the symptoms. By applying the syndrome test we can at once class our patient under Group A or B, a classification that helps us to discover the cause. In Class A the diagnosis lies between true gout and true rheumatism, and is therefore as a rule comparatively easy, and the treatment is more or less specific. In Class B the diagnosis will lie, in nine cases out of ten, between gonorrhœal, rheumatoid, and toxic arthritis, and, if it is toxic arthritis, we may perhaps be able to remove the cause, whether it be a tooth, a tonsil, or an infected gall-bladder, without wasting time in attempting to relieve symptoms. But gonorrhœa as the primary cause is exceedingly common, embracing probably 10 per cent. of all "rheumatic" cases. Cases coming under Class B require a *tonic* line of treatment, in other words the resistance of the patient to micro-organisms and toxins must be increased. The whole group would appear to offer a peculiarly appropriate field for vaccine treatment.

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The Vaccine Treatment of Rheumatoid Arthritis.[1]

By H. Warren Crowe, M.D., B.Ch.Oxon.

(ABSTRACT.)

The difficulty of definition was first discussed. The literature dealing with the vaccine treatment of the disease was then reviewed. It appeared that, at the present time, authorities considered that vaccine treatment was useless if not harmful. From time to time, however, a few successes had been recorded. These fell naturally into two groups. In the one a focus of infection was found and autogenous vaccines used. In the other group large doses of non-specific bacterial antigen had been employed as in the method of protein shock.

A table was shown comprising cases all treated on identical lines. The results had been remarkably satisfactory. It was not too much to say that no other method of treatment, either by vaccines or without, had ever given results in any way comparable with those now brought forward.

The hypothesis on which the cases were treated had already been described elsewhere, but could be briefly re-stated thus: (1) The disease due primarily to the *Micrococcus deformans* (described by the author in 1913). (2) Secondary infections frequently present as in tuberculosis. (3) These secondary infections responsible for the variety of joint

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[1] At a meeting of the Section, held November 16, 1920.

manifestations. (4) *Micrococcus deformans* responsible for the neuropathies which are the only symptoms common to all cases of rheumatoid arthritis. Stress was laid on the fact that the experience of the author was the reverse of that of the earlier writers who had stated with peculiar unanimity that, unless a focus was found, vaccines were useless (the second group above mentioned is not here in question) and that stock vaccines had not been of benefit. He had found that stock *Micrococcus deformans* vaccine used alone, in the absence of a discoverable focus, was responsible for a larger proportion of successes than where a combination of vaccines had to be employed.

Micrococcus deformans vaccine was extremely toxic in most cases, and minute doses were required. Patients were apt to become extraordinarily sensitive, and this fact constituted the main difficulty in the treatment. Methods of combating the condition of sensitiveness had been described elsewhere.

Pituitrin-like Body in the Cerebro-spinal Fluid.[1]

By W. E. Dixon, M.D., F.R.S., and Douglas Cow, M.D.

(ABSTRACT.)

Experiments were made on anæsthetized dogs and cats, in which the sub-cerebellar cisterna was tapped by a cannula, and the cerebrospinal fluid collected at regular intervals of time. Substances were then injected into the circulation, and the cerebro-spinal fluid subsequently tested on the isolated uterus and other isolated organs as well as on the intact animal.

Normal cerebro-spinal fluid has no action on these tissues in amounts up to about 3 c.c. Injection of extracts of intestinal mucous membrane or ovary caused in each instance, after a latent period of about an hour, a secretion of cerebro-spinal fluid containing a substance having all the physiological properties of extracts of the posterior lobe of the pituitary.

Extracts of testis, epididymis, liver, pancreas, choroid plexus, &c., and such drugs as histamine, pilocarpine, and adrenalin had no effect.

Pituitary extract (posterior lobe) caused an immediate appearance of this active substance in the cerebro-spinal fluid.

[1] At a meeting of the Section, held November 16, 1920.

CORRIGENDUM.

Proceedings, 1920, xiii (Section Therap.), p. 99, last line, for "Atropin" read "Atophan."

Section of Therapeutics and Pharmacology.

President—Dr. H. H. Dale, C.B.E., M.D., F.R.S.

PRESIDENT'S ADDRESS:

Recent Tendencies in Chemotherapy.[1]

By H. H. Dale, C.B.E., M.D., F.R.S.

Perhaps the most noteworthy recent change in pharmacology and experimental therapeutics has been the shifting of the centre of interest towards the specific treatment of infections. Until the closing decades of last century pharmacology, so far as practical therapeutics was concerned, dealt mainly with symptomatic treatment. Pharmacology concerned itself mainly with the exact description and analysis of the mode of action of remedies of approved value, and the attempt to discover others having actions of the same kind in enhanced degree, or free from undesirable associated effects. Since medical treatment was predominantly concerned with the relief of symptoms, it was a natural consequence that pharmacology should have the same tendency. There were, indeed, a few specific remedies for infections, which had a reputation based on long-standing tradition and established by empirical observation. It was known that cinchona, and more especially its earliest discovered alkaloid—quinine, had a specific action in malaria; that ipecacuanha was a specific remedy for many cases of tropical dysentery; that mercury and potassium iodide were valuable in different stages of syphilis, and sodium salicylate in acute rheumatism. The organisms responsible for these infections, however, were unknown, and the remedies were characterized by general and rather ill-defined toxic actions, which did not form attractive subjects for pharmacological analysis, and bore no clear relation to their specific remedial effects.

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[1] At a meeting of the Section, held January 18, 1921.

In the case of quinine, Binz, as long ago as 1868, had put on record a remarkable prophecy. Being struck with the visible effects of quinine on free-living protozoa, he made a penetrating surmise as to the probable nature of the unknown cause of malaria; but the most devout pharmacologist may hesitate before claiming its correctness as an example of sound scientific reasoning. We know now that malaria is due to a protozoan parasite, but we have little ground for supposing that the effect of quinine upon it is comparable to that which Binz observed on infusoria. The general tendency, however, at the time of which I speak was probably to regard quinine as specifically and directly affecting the malarial infection, and having also an action on the patient, partly of an undesirable kind.

The lack of relation between general action and specific value was even more pronounced in the case of ipecacuanha. Evidence had been produced, indeed, to show that the emetic alkaloids were responsible for the action on dysentery. This was curiously ignored, however, and the toxic action on the patient was regarded as merely an inconvenient complication of the specific effect on the parasite. Until quite recent years ipecacuanha deprived of its alkaloids, and thereby of its emetic action and, as we now know, of its curative value, was widely used in the treatment of dysentery.

With specific therapeutics in this condition, it is no matter for surprise that laboratory pharmacology found more attractive problems in the finer analysis of the action of alkaloids and glucosides, having well-defined physiological effects, and tended to form an ever closer alliance with physiology and to lose contact with the obscure problems of the treatment of infections.

The rapid development of the science of immunity, and its successful application in several directions to the treatment of bacterial infections, threatened to divorce pharmacology even more completely from specific therapeutics. And when at length bacteriological methods seemed, in certain directions, to find a limit to the efficacy, when infections were encountered to which immunological treatment seemed inapplicable, the investigation of drugs and chemicals as specific remedies for infection seemed to start from a new point of view which the study of immunity had imposed. Search was to be made for new substances, produced in the laboratory, which, like Nature's antibodies, should be harmful only for the infecting parasite and harmless for the host; which should have maximal "parasitotropic" and minimal "organotropic" properties. Pharmacology might continue its academic inquiry into the mode of action of traditional remedies and its search for natural active principles. The new search for specific remedies, for "magic bullets," as Ehrlich picturesquely conceived them, which would bring down the parasite unerringly and leave the host unscathed, must be constituted as the new science of chemotherapy.

I suppose that many years must pass before we can justly appraise the part played, in laying bare the mechanism of immunity, by the side-chain theory of Ehrlich. There are probably not many now who believe that it will prove to be permanently acceptable as a scientific presentation. It may be doubted whether Ehrlich himself, in his later years, regarded it as more than a useful diagram, by which facts already ascertained could be summarized and brought into some kind of logical connexion, and by which new lines of investigation could be suggested. It is difficult for one who, even for a brief period, came under the influence of his stimulating personality, to take a completely detached view. His eager and fertile imagination worked naturally along the lines of his favourite study of the synthetic dyes, and looked inevitably for analogies to biological phenomena in structural organic chemistry. It can hardly be doubted to-day, and I believe that he realized it himself, that a study of the complex physico-chemical problems involved in the reactions of immunity, with the aid of the new developments in colloidal chemistry, is bound ultimately to modify profoundly the conception of their mechanism. Meanwhile, however, the side-chain theory seemed to have favoured, rather than impeded progress in one branch of specific therapeutics, and might yet do service in the new science of chemotherapy, which was to displace the old-fashioned pharmacology, where the attack on infections by means of drugs was concerned. The problem was to be the discovery of substances adapted to the receptive side-chains of the protoplasm of the parasite, fixing themselves to it with a maximal affinity and bringing to bear on it the poisonous properties of a toxophore grouping, and at the same time having a minimal affinity, and therefore a minimal toxicity, for the tissues of the host. Action on the host was to be regarded as something to be avoided and eliminated as far as possible. Its pharmacological details would be largely irrelevant.

The search for new remedies along these lines had already been in progress for some years when it was brought almost to a standstill by the outbreak of the world war. It has appeared to me that this might be a useful opportunity to review its achievement, and especially to consider certain items of evidence, obtained during the last few years, which seem to me to raise a doubt as to the theoretical basis of the chemotherapeutic programme, and to suggest that the older methods, with their appearance of less directly practical aim, and their more laborious study of the effect on the patient, cannot as yet be safely discarded if we are to gain a clear conception, even of the effect of a chemical remedy on the progress and persistence of an infection.

It would be foolish to deny to the newer method of attack at least one achievement of first-rate importance. The dyes, the action of which furnishes probably the clearest example of a directly "parasitotropic" action, have hardly fulfilled their early promise. Trypan-blue seems to have established itself as a remedy for piroplasmosis in domestic animals, but, beyond that, there is as yet no considerable therapeutic success to be recorded for this group. The really important success came from another direction. The organic arsenical compound which had been marketed under the name "atoxyl," was shown in this country to cause the disappearance of trypanosomes from the circulation of a small animal infected with them. Ehrlich and Bertheim, by establishing the true chemical structure of this substance, opened the way for the preparation of a large series of derivatives. It can hardly be expected that all the conclusions, as to the adjuvant or dystherapeutic effect of this or that grouping, which were reached during the intensive investigation which followed, will prove to have a general or permanent validity. A conclusion of major and probably of permanent importance, however, was that as to the greater efficacy of the compounds containing arsenic in the trivalent form, as compared with the corresponding compounds with pentavalent arsenic. With this point established, the road was cleared along which salvarsan was ultimately reached. No future development can weaken the claim of Ehrlich and his colleagues to credit for this pioneer achievement. There were early indications, however, that a favourable ratio between parasitotropic and organotropic action would not wholly suffice to account for the wide margin between therapeutically effective and dangerously toxic dose, even in the case of this truly remarkable remedy. Tested on spirochætes *in vitro* it proved surprisingly harmless, though parasites so treated seemed to have lost their power of infection. Levaditi found that the addition of liver emulsion gave to salvarsan the power of killing spirochætes even *in vitro*, and there are various other indications that the host's tissues do not play an indifferent part in the therapeutic process.

It seems quite possible, as has recently been suggested by Voegtlin and his co-workers in the Public Health Department at Washington, that the really effective agent is the arsenious oxide (m. amino-p. hydroxyphenylarsenious oxide), derived from salvarsan by partial oxidation in the body. If this be true, the question naturally arises why this substance, which would present no insuperable difficulties of manufacture, which is more stable and easier to administer than salvarsan, should not be used as such. I think the answer is probably to be found by considering a factor, in the specific treatment of infection by drugs, which has hardly received as yet the full attention which it deserves—the factor of persistence of action. The arsenious oxide corresponding to salvarsan is more toxic, indeed, than the latter for the mammal; but it is also more toxic for the parasite. Ehrlich and his colleagues had observed that this substance had a powerful, rapid but evanescent action on an infection with trypanosomes or spirochætes, the blood being quickly cleared of parasites, but early relapse being the usual sequel. Shock tactics in such a case are ineffective; flooding the body for a brief period with even the maximal concentration of the substance which it will tolerate, a concentration which falls rapidly as the freely soluble substance is eliminated, will not eradicate the infection. For this the steady maintenance over a prolonged period of even a much lower concentration is far more effective. And here I believe we can find the secret of the efficacy of salvarsan. Not that it is directly toxic for the parasite; seemingly it is not so; but that, being an almost insoluble substance at the slight alkalinity of the blood and tissues, it can circulate in the blood only in a colloidal form, protected from aggregation by the plasma proteins; and that, being quickly deposited in the tissues, it there, by slow oxidation, keeps up a steady supply of the really efficient parasiticide until it is all eliminated. It would be fair to argue, I think, that even salvarsan owes to its organotropic rather than to directly parasitotropic properties, its greatly superior efficacy in comparison with that of its soluble, toxic, and directly acting derivative.

When we pass to the other cases in which specific chemical remedies have proved successful in combating infections, it becomes even more obvious that a conception of their action is inadequate, which regards an action on the organs and tissues of the host as merely an undesirable complication of the direct action of the remedy on the parasite. In the case of ipecacuanha there was evidence of many years' standing that the alkaloid was the effective constituent in the treatment of dysentery. As early as 1891 Tull Walsh and Warden had found that the total alkaloid of ipecacuanha, the "emetine" of that period, cured cases of dysentery which were unaffected by the ipecacuanha deprived of its alkaloids. The observation seems to have been forgotten. Later, the separation of the different alkaloids by the chemists, and the differentiation of amœbic from bacillary dysentery, gave the opportunity for a re-discovery of the essential fact, and its statement with greater precision. The time was also ripe for its incorporation into the chemotherapeutic scheme. This appeared to have been effected when Vedder observed that the growth of free-living amœbæ was inhibited by high dilutions of emetine and cephaëline, and when Rogers described the rapid immobilization and death of *Entamœba histolytica* itself, obtained from a dysenteric stool, by contact with a solution containing only one part of emetine hydrochloride in 100,000. Here, at least, seemed evidence of a direct parasiticidal action, and a basis for a simple explanation of the curative effect of the alkaloid, which clinical experience demonstrated.

That this renewed application of the alkaloids of ipecacuanha, and of pure emetine salts in particular, has effected an enormous improvement in the treatment of amœbic dysentery, is beyond question. The accuracy of the observations on which it was founded, and of the conception of the action to which they gave rise, is by no means so thoroughly established. The need for improving the treatment of amœbic dysentery during the war supplied an incentive to Mr. Dobell and myself for repeating these experiments, and extending them to other natural alkaloids of ipecacuanha, and to artificial derivatives from them. The amœbæ were obtained from kittens infected with strains of *Entamœba histolytica* obtained from human cases, and a few confirmatory observations were carried out on amœbæ obtained direct from man. The results were surprising and, I think, significant. Emetine and cephaëline, so far from exhibiting a specially lethal effect on *Entamœba histolytica* outside the body, had little apparent action even in quite strong solutions, up to 1 per cent., on thoroughly healthy parasites, taken direct from the ulcerated bowel of the freshly killed kitten. They were much less harmful to such amœbæ than other alkaloids, such as quinine and harmaline, which have no specific action on the infection. In the series of natural ipecacuanha alkaloids, and artificial derivatives which we examined,[1] several were found which were more toxic for the amœbæ *in vitro* than emetine or cephaëline, and at the same time much less toxic for mammals, including man. Yet these other alkaloids, more parasitotropic and less organotropic than emetine or cephaëline, have all proved to be without therapeutic value in amœbic dysentery. Several of them were administered to human patients by Dr. G. C. Low. They could be given in relatively large doses, without producing nausea or other symptoms, which much smaller doses of emetine would cause, but also without producing any perceptible effect on an amœbic dysentery, which afterwards cleared up rapidly under emetine. A compound produced by methylating emetine on a nitrogen atom, retained some of the therapeutic effect in dysentery, but also some of the emetic action of the parent alkaloid. Even the artificial iso-emetine, differing from emetine only in the asymmetry of a carbon atom, having only about one half of the depressant effect of emetine on the heart and practically no emetic action, proved quite without value in the treatment of infection with *Entamœba histolytica*. In this series of alkaloids, if the results of experiment mean anything, curative action is related to toxic action on the host, and bears no kind of relation to direct toxicity for the parasite. That action on the host is an essential feature in the therapeutic effect is further suggested by the fact that emetine itself, in any dose, failed in any way to influence the course of dysentery in kittens, produced by strains of amœbæ from human cases, in which emetine subsequently effected a normal and permanent eradication of the infection. The search for a remedy for dysentery in the emetine series, with maximal parasitotropic and minimal organotropic properties, leads us definitely astray; there seems no hope of real progress here until the older pharmacology can give us more precise knowledge as to the mode of action, the distribution and the fate of these alkaloids in the mammalian organism. We must know in what way emetine changes the tissues of the host, so as to make it impossible for the obligate tissue-parasite, *Entamœba histolytica*, to penetrate the tissues and obtain the only food on which it can thrive and multiply, while its harmless, saprophytic relatives, *Entamœba coli* and *Endolimax nana*, remain unaffected.

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[1] For all these we were indebted to Dr. F. L. Pyman, then director of the Wellcome Chemical Research Laboratories.

In the action of quinine in malaria, again, we meet with an effect which finds no really satisfactory explanation in the assumption that this alkaloid has a specific toxicity for the parasite. Demonstrations of the toxicity of quinine for free-living protozoa cannot fairly be applied in explanation of the effect on malaria; if quinine cured malaria simply in virtue of its action on protozoa, its inefficacy in the closely similar

Halteridium infection in birds would be quite inexplicable. It is significant that Morgenroth, a former collaborator with Ehrlich, and a faithful adherent of the parasitotropic explanation of the action of salvarsan, finds it necessary to put forward an ingenious theory of a totally different type in explanation of the action of quinine in malaria. By physiological and bacteriological methods of assay he has convinced himself that quinine is preferentially taken up by the red corpuscles. In that position it is supposed either to kill the intracorpuscular parasites, or, more probably, to exercise a repellent effect on the merozoites, which must penetrate the red corpuscles or perish without further development in the plasma. By this hindrance to infection of the red cells asexual multiplication is brought to an end and the disease eliminated. Among a number of observers who have used chemical methods, none have obtained evidence of this distribution of quinine in blood in favour of the corpuscles. Ramsden and Lipkin found the greater part in the plasma, and recent observations made by Acton and King, in the National Institute for Medical Research, indicate a practical equality of distribution. It is of interest, however, to find that even those who were closely associated with the ideas of the Ehrlich school are turning, for an explanation of the action of quinine, to a conception which bases it on a property essentially organotropic, and not parasitotropic.

In other directions I believe that the same tendency will presently manifest itself. Among recent successes of specific therapeutics by chemical agents must certainly be reckoned the discovery of the action of tartar emetic, first in kala-azar and more recently in bilharzia infection. The original suggestion for the trial of antimony compounds, in place of those of arsenic, came from a former President of the Section, Professor Cushny; but the successful applications have been largely the result of empirical clinical observation. There is no theoretical ground for supposing that a substance which cures kala-azar is likely to remove infection by bilharzia. Especially surprising was the discovery that the irritant eggs of the trematode parasite, to the action of which, in working their way through the tissues of the bladder and bowel, the symptoms of the disease are due, are killed and deprived of their irritant properties under the treatment with tartar emetic. It should not be difficult to discover whether the eggs, when observed *in vitro*, are killed by dilutions of tartar emetic comparable to those which are tolerable in the blood and tissues of the living man, and we may expect that investigations along these lines will clear our conceptions concerning a much wider field of chemotherapy than that of the immediate problem of tartar emetic and bilharzia. That the action will prove to be anything so simple as a direct action of the drug on the parasite is rendered additionally improbable by the more recent accumulation of evidence that emetine also, though doubtfully as yet in the same degree, has a similar specific remedial action on infection by bilharzia, and, according to still more recent evidence, on kala-azar. It seems difficult to suppose that emetine should owe its efficacy in amœbic dysentery, on the one hand, and in bilharzia infection on the other, to a specific chemical relationship both to *Entamœba histolytica* and to the schistosomes and their ova; or that the latter should possess specific receptors both for emetine and for tartar emetic.

It is from such considerations as these that I am led to believe that the tendency to regard chemotherapy as a field for the organic chemist and the parasitologist, and to eliminate the pharmacologist, is at least premature. I believe that a patient and careful analysis, of the effects of these remedies on the host, will prove to be an essential step towards a clear understanding of the method by which their administration influences the power of the parasite to maintain and propagate itself in the blood and the tissues. Brilliant with promise in its beginning, chemotherapy seems to have reached a point where its successes are the result of luck and empirical trial; nothing but fuller knowledge can give us that rational basis of theory from which an orderly, scientific progress can result.

Section of Therapeutics and Pharmacology.

President—Dr. H. H. DALE, C.B.E., M.D., F.R.S.

The Influence of the Electric Current on the Absorption of Drugs.[1]

By O. INCHLEY, M.D.

(ABSTRACT.)

AN account was given of the results of experiments made to determine the amount of absorption of drugs through the skin by means of the electric current. Rabbits, cats or guinea-pigs were used, anæsthetized with urethane. The electrodes employed were described. The amperage, time, the area of skin treated, and the concentration of drug, were given in each case. Absorption through the skin was proved in the case of atropine, aconitine, and the cyanide ion; tracings showing the known pharmacological effects of the drug being recorded on the kymograph in each case. With strychnine return of reflexes was obtained. Absorption of iron from ferrous sulphate solution was shown by increased percentage of iron in the skin and underlying muscle determined by chemical estimation. Calcium absorption, from calcium chloride, was proved by its effect in reducing the clotting-time of the blood to half the normal. Experiments on the knee-joint were described showing absorption through the skin of the salicylate ion and of the ferricyanide ion; penetration was estimated by staining the excised and opened joints with ferric chloride or ferrous sulphate solution respectively. The current caused no deeper penetration than could be obtained by simple subcutaneous injection of the same concentration of drug under the skin covering the joint. Thus, with potassium ferricyanide solution there was more intense staining of the deeper tissues (cartilages of femur, tibia), when injected subcutaneously than when introduced by the current. With sodium salicylate no penetration into the joint occurred either when injected subcutaneously or when introduced electrically. The superficial tissues (outer surface of capsular ligament, patellar tendon and fascia) in one experiment were equally well stained by both methods of introduction, while in another there was intense but superficial staining in the electrically treated joint, but very slight staining in the injected one.

The Oral Administration of Pituitary Extract.[2]

By P. HAMILL, M.D., F.R.C.P.

CLINICAL evidence has amply demonstrated that thyroid extract administered by the mouth is absorbed and produces definite effects. In the case of other glands of internal secretion the results are less definite. It therefore seemed desirable to make some critical observations on the subject. Pituitary extract was chosen for its action after injection has been fully studied and is readily recognizable. Some clinical observations were made on the human subject but for the most part experiments were carried out on cats.

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[1] At a meeting of the Section, held December 14, 1920.

[2] At a meeting of the Section, held February 15, 1921.

The animals were anæsthetized with ether or ether and urethane, in some cases they were decerebrated and no further anæsthesia was then required; in others artificial respiration was provided and the animals decapitated, and in one experiment the spinal cord was also destroyed in order to eliminate all possibility of reflex effects. Records of blood-pressure were taken in some cases; in all cases the uterus was connected to a recording lever and its movements registered.

Preliminary observations showed that soon after the necessary manipulations were completed the uterus relaxed and that thereafter there was no increase in tonus or in the size of the normal contractions in two or three hours. If, on the other hand, a dose of pituitary extract diluted with 10 to 15 c.c. of saline were administered by stomach-tube there followed after an interval a definite rise of tonus and large rhythmic contractions of the uterus. In some cases the delay amounted to about half an hour, but it was observed that in animals which had been recently fed and whose stomachs were full the contractions and rise of tonus set in much sooner, sometimes within ten minutes. These observations suggested that absorption took place from the stomach rather than from the small intestine and experiments were carried out to test this point. It was found that after the pylorus had been doubly ligatured, and also that when after ligature the whole of the intestinal tract from the pylorus to the rectum had been excised, the usual increase of uterine activity was obtained after the administration of pituitary extract by the stomach tube. The evidence is therefore clear that pituitary extract is absorbed from the stomach with considerable rapidity.

Whether absorption takes place from the intestine is more difficult to determine. It is known that in the presence of pancreatic juice pituitary extract is quickly destroyed *in vitro*, but it is not impossible that some may be absorbed before destruction takes place. Some evidence was obtained that this, in fact, occurs, but graphic records were difficult to obtain because of the violent peristaltic action of the intestine, and straining, which upset the recording apparatus. Further observations on this point are in progress.

Intestinal Movements.—In a large proportion of cases in which the intestines were not removed it was observed that about half an hour after the administration of pituitary extract violent segmentation and peristaltic contractions set in and vomiting frequently followed. These contractions were obtained rather less frequently when the pylorus had been ligatured and the dose of pituitary was not large. They were equally obtained when (after ligature of the pylorus) the pituitary extract was introduced by a tube sutured into the gut. Control experiments in which saline solution alone was used were negative in this respect.

Blood-pressure.—So far no satisfactory evidence of action on the blood-pressure has been obtained. In most cases there was a very slight gradual fall of blood-pressure probably from the shock of the manipulations, but in one case after a latent period of an hour there was a slight rise of pressure which continued, but the normal level was not reached within two hours although the uterus was strongly contracted. This point is still under investigation.

Diuresis.—No observations have so far been made.

Dosage.—The dosage usually employed has been 0·5 to 1 c.c. of pituitary extract for animals of 3·5 to 4·5 kilos corresponding to doses of the order of 10 c.c. in the human subject. Such doses are large but are desirable in a general investigation. Much smaller doses, corresponding to about 3 c.c. for the human subject, have produced definite strong uterine contraction within half an hour.

Some observations on the human subject in delayed involution of the uterus have shown a diminution of blood loss whilst pituitary extract was administered and recurrence when it was withheld. With doses of 1 c.c. three times daily, nausea, retching and slight generalized colicky pains have been produced. These symptoms appear to correspond to the intestinal contractions and vomiting described above. Attention has been called to these symptoms in man by other observers.

SUMMARY.

Animal experiments prove that pituitary extract administered by the mouth causes the characteristic uterine contractions.

Absorption takes place from the stomach and is more rapid when the stomach is full and actively digesting.

Large doses produce colicky contractions of the intestine and vomiting.

Clinical evidence harmonizes closely with animal experiment.

In view of the rapid absorption from the stomach and the fact that the intestinal juices rapidly destroy the active principle it appears preferable that pituitary extract should be administered in solution and after meals.

[Graphic records in illustration of this communication were shown on the epidiascope.]

The Use of Pituitrin by Mouth in certain Cases of Uterine Hæmorrhage.

By MALCOLM DONALDSON, F.R.C.S.

IT is never an easy task to demonstrate the therapeutic value of a drug, and the difficulty is increased when the drug is used for a minor ailment which does not necessitate the patient being under continuous observation. Such then is the difficulty I have to contend with in trying to prove that pituitrin by mouth is a most valuable drug in treating certain cases of uterine hæmorrhage.

I have been using pituitrin for about eighteen months, both in private and in the hospitals to which I am attached.

ROUTINE METHOD OF TREATMENT.

Every patient complaining of uterine hæmorrhage is carefully examined to exclude the possibility of carcinoma, large fibroids, or other condition requiring urgent operation. This, then, leaves for treatment cases of endometritis, small fibroids, retained products of conception, cases of menorrhagia and epimenorrhœa, including those cases where the exact cause cannot be diagnosed but is probably ovarian in origin.

The drug is always prescribed in tablet form, 2 gr. three times a day after food. It has been suggested that it should be given in a fluid form, in order to promote absorption by the stomach.

In two of the hospitals I have treated about fifty cases in the last six months. Of these, thirty-seven responded to treatment, some within a few days. Of the remainder, four did not return to report: five were subsequently admitted and found to have polypi, &c., and in four the notes state definitely that no improvement took place.

In private I have had cases which responded to pituitrin after being treated for weeks with ergot and other drugs.

Personally, I am convinced of the value of pituitrin by mouth, and this opinion is shared by all the clinical assistants and house surgeons I have had working with me.

The Vitamin Content of certain Sun-dried Vegetables.

By J. A. SHORTEN, Major I.M.S.

THE manufacture of sun-dried vegetables is a new and important Indian industry by which various vegetables, after suitable preparation, are dried in the open air. The hot dry winds of Quetta in Baluchistan render this procedure possible. The essential climatic conditions which obtain there are a high temperature, a practically rainless summer, great air movement and low humidity. Under such conditions most vegetables can be completely desiccated in less than a day.

The idea originated with, and the vegetables are prepared under the direction of, Mrs. G. L. C. Howard, Second Imperial Economic Botanist to the Government of India. The preliminary preparation includes cleaning, slicing, and scalding or steaming for a short time. The slices are then spread on suitable trays exposed to the sun, and collected when completely desiccated. They are subsequently compressed into bricks 1 lb. in weight, and packed in air-tight tins. Vegetables thus prepared retain in a high degree their original colour and flavour, even when cooked after a preliminary soaking in water.

The present communication deals with animal experiments made with a view to determining the antiscorbutic and antineuritic properties of these sun-dried vegetables. Investigations into the antiscorbutic properties were determined by experiments on guinea-pigs, and the antineuritic properties were tested on fowls. The usual basal diets were employed, and a weighed quantity of the vegetable under investigation was added to the daily ration.

The vegetables investigated were: (1) carrots, (2) brinjal, (3) spinach, (4) cabbage, (5) tomatoes, (6) potatoes, (7) turnip tops, (8) turnips, (9) a specimen of a mixed factory-dried product prepared by Messrs. Swallow and Ariel, Port Melbourne, Australia.

The results obtained are briefly as follows: Of the sun-dried vegetables tomatoes, cabbage and potatoes, in the order named, retain a considerable amount of their original antiscorbutic properties. Tomatoes were particularly effective, none of the animals showing signs of scurvy, the body-weight being well maintained during the three months of experimental feeding, whereas the controls on the basal diet only died on the thirty-second day. The remaining varieties showed little, if any, antiscorbutic virtues, although an equivalent ration of the fresh vegetables afforded complete protection in every case. The animals fed on the mixed factory-dried product showed no protection from the disease, all dying between the twenty-fifth and thirty-seventh days.

None of the sun-dried varieties showed loss of antineuritic substances as compared with the fresh vegetables.

Attention was drawn to the influence of cooking on the antiscorbutic factor. In every experiment one group of animals was fed on the sun-dried products soaked in water but uncooked, another group on the vegetable soaked and cooked as directed by the producers. In almost every instance animals in the former groups lived longer than those in the latter. We may conclude, therefore, that sun-dried vegetables, when possible, should be given in the form of salads.

It is possible that omitting the scalding or steaming process may influence the amount of retained vitamin. It is to be noted that the vegetables which proved the most effective are of comparatively coarse texture, and that therefore the protoplasm of the cells, with its presumed vitamin content, is less liable to damage by heat than that of the finer varieties, Experiments designed to test this hypothesis are in progress, and the results will be reported in due course.

Section of Therapeutics and Pharmacology.

President—Dr. H. H. DALE, C.B.E., M.D., F.R.S.

Kaolin in the Treatment of Asiatic Cholera: Its Action and Uses.[1]

By R. R. WALKER, B.Ch.

THE cholera bacillus is a small, highly motile organism, 1·5 to 2 μ in length, curved on one axis and provided with a single flagellum. It grows freely in alkaline broth or on alkaline agar. It stains readily with weak carbol fuchsin and solutions of the culture give a rose-pink colour reaction on the addition of pure sulphuric acid; also, according to Greig, true *Vibrio choleræ* is non-hæmolytic. Agglutination tests against a high titre anti-cholera serum will differentiate between the true cholera and paracholera or El Tor vibrios.

The disease in man is characterized by general systemic disturbance—vomiting, profuse watery diarrhœa, muscular cramps, cold, clammy condition of the surface, suppression of urine, are the general characteristics. The onset is sudden as a rule, and in the most virulent infections a condition of cholera sicca occurs, in which the patient dies before the diarrhœa has set in.

Treatment has been directed to meet all conditions which occur. Potassium permanganate, opium, saline injections, subcutaneously and intravenously, with hypertonic solutions of saline (Rogers) have been used with considerable effect.

During the epidemic at the close of the Balkan War, 1900, Stumpf's bolus treatment (bolus albus) was tried at Nish by Dr. Victor Kuhne[2] with remarkable results. Bolus albus or kaolin (China clay) is aluminium silicate $H_4Al_2SiO_9$, a salt insoluble in water, with crystals of 1 μ in length in a fine state of division. This salt was in use in early Roman times, and was also used by the natives of the Orinoco. It has been employed in diphtheria in Germany, as a powder, insufflated on the fauces and tonsils, and also as a mixture internally. It has been used in ptomaine poisoning with success (Mutch), also in dysenteries, and in the treatment of sprue, and toxic conditions. The general effect of the salt seems to point to the adsorption of toxins. Kuhne claims that the mortality in the cases treated with kaolin was reduced from 60 to 3 per cent. The method of preparation was as follows: A suspension was made of equal amounts of water and kaolin, the kaolin being stirred into the cold water (i.e., 100 grm. kaolin to 250 c.c. aq.). Half-pint doses of this suspension were taken half-hourly for the first twelve hours. During the second twelve hours several glasses were taken according to the patient's condition. Vomiting soon ceased, the pulse improved, and the patient slept.

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[1] At a meeting of the Section, held April 19, 1921.

[2] *Rev. Med. de la Suisse Rom.*, September, 1918, p. 555.

In the summer of 1919 China was visited by a severe epidemic of cholera. Dr. Louis Braafladt, of Tsinanfu, gives, in the *China Medical Journal* of May, 1920, the result of the use of kaolin. The method of administration was somewhat different from Kulme's, and his results are as follows: Patients having—

(1) Hypertonic saline treatment (after Sir Leonard Rogers), mortality 22 per cent. Convalescents discharged on the eighth day.

(2) Kaolin and hypertonic treatment, mortality 29 per cent. Convalescent patients discharged on the sixth day.

(3) Kaolin treatment only, mortality in thirty-five cases one patient (this patient died of gangrene of uterus after miscarriage). Convalescent patients discharged after four days.

All these patients had true cholera vibrios isolated during their stay in hospital.

In the cases of Asiatic cholera treated in Foochow at the American Red Cross Hospital when first opened, no definite hard and fast line of treatment was maintained. Cases were treated by continuous subcutaneous injection of normal saline, with administration of potassium permanganate by the mouth until the motions became green. Hypertonic intravenous saline injections (Rogers) were given in amounts up to 3 litres or until the blood-pressure became normal. Dextrose was added in some cases to the intravenous solutions.

Whatever method was used, some features of the disease remained constant:—

First, although the patient on arrival might appear moribund, being cold, rigid and with imperceptible pulse, the introduction of saline could usually be relied on to produce return of consciousness and a greatly improved pulse. With the hypertonic intravenous solutions a rigor of great intensity could be looked for before the end of the introduction of the second litre. This, however, was disregarded, and the saline was continued until the blood-pressure had attained the normal.

Secondly, relapses were the rule—in fact sometimes even before the completion of the injection of a second patient was completed, the first patient, through excessive diarrhœa and vomiting, might be urgently requiring more fluid.

Thirdly, cases which could be supported until the acute diarrhœa and vomiting had passed, were still in grave danger from suppression of urine. This persisted in some of the cases six days. The only remedy seemed to be the use of almost continuous "cupping," usually by means a de Bier's suction glass over both kidneys.

During the epidemic in Foochow, in the summer of 1919, kaolin was used by myself with considerable success, but there was difficulty in obtaining a good supply. On my return to Hing Hwa, where cholera was raging, I had no difficulty in obtaining kaolin, as the famous Blanc de Chine clay beds are situated near this district.

The method of administration was somewhat different from Stumpf's methods. A large supply of half-and-half suspension was placed near the patient, and the patient was encouraged to take as much as possible. At first large quantities could be tolerated, but as the vomiting and diarrhœa ceased the liquid was refused. In all cases food was withheld for eighteen to twenty-four hours, then rice water was allowed, and later milk and rice water. In all cases rectal lavage was done with kaolin solution thickened until it would comfortably pass through the rectal tube. At first some was returned, later much was retained. If the condition was precarious on arrival at hospital, subcutaneous bilateral infusion usually restored the patient sufficiently to take the kaolin by the mouth. In desperate cases hypertonic salt solution was given intravenously (Rogers) but not in such large quantities as we used before the introduction of the kaolin treatment (2 litres) This is shown to be of value by the results obtained by Braafladt with hypertonic saline and kaolin, which were not, however, so good as those obtained with kaolin alone.

After the introduction of the kaolin method the following differences were noted :—

If the patient's condition was "fair," that is, if the pulse was perceptible and the patient conscious, the introduction of large quantities of kaolin suspension by the mouth and *per rectum* would ensure continued recovery. After two hours all vomiting ceased, a sense of safety had been reached, and the patient usually slept.

In the lighter cases the diarrhœa ceased within twelve hours and urine was passed within from twenty-four to thirty-six hours.

In the most critical cases, which required the introduction of saline to bring about an improvement of the pulse, rectal introduction of heavy suspensions of kaolin was commenced at once and had a perceptible effect in preventing the further loss of fluid. On return of consciousness and during the introduction of the saline, kaolin was given by the mouth, and was usually retained, while in those cases in which there was vomiting, it was thought that some kaolin which had been deposited on the walls of the stomach had begun to adsorb the toxic products of the cholera vibrio, and the second administration of the kaolin suspension by the mouth was frequently retained, or only partially returned.

The distinctive advantages of the kaolin treatment were :—

(1) Simplicity of method.
(2) Absence of relapse.
(3) Cessation of loss of fluid.
(4) Great improvement owing to adsorption of toxins, the patient becoming rapidly free from a general "toxic condition."
(5) Early return of the passage of urine.
(6) Early and rapid convalescence.

In St. Luke's Hospital, Hing Hwa, we had a series of seventy-five cases from one village, situated two hours' journey from hospital, with no fatal results, and this in spite of the fact that many of the patients arrived in a condition of extreme collapse. The mortality of untreated cases at this village was stated by the village headman to be exceedingly high, though I was unable to obtain exact figures, as in China there is no registration of deaths.

LABORATORY EXPERIMENTAL WORK ON THE ACTION AND EFFECT OF KAOLIN.

Rabbit fed with 20 c.c. of a 50 per cent. kaolin suspension : on chloroforming eighteen hours later, it was found that there were well-marked traces of kaolin over the walls of the stomach, duodenum and upper small intestine, increasing in amount down the lower small intestine to the cæcum, which was full of liquid contents mixed with kaolin. The colon was full of dry masses of dark brown fæces which, on opening, showed white kaolin inside.

Rabbit fed with 20 c.c. of a 50 per cent. kaolin suspension and also 20 c.c. of a 50 per cent. kaolin suspension rectally, chloroformed forty-two hours later :

the stomach and duodenum distended by a new vegetable meal showed no signs of kaolin, but there were traces on the walls of the upper small intestine which increased in amount to the cæcum, while the transverse and descending colon were full of dry masses of kaolin and fæces mixed.

A further experiment showed the microscopical appearance and the position of the kaolin in the intestinal tract. A rabbit was fed at 9 a.m. with 20 c.c. of a 30 per cent. kaolin and water mixture. At 12 mid-day this was repeated, and the rabbit killed at 2 p.m. Sections of the stomach, upper and lower small intestine and large intestine were taken, the gut being stretched on cork rings to prevent retraction on hardening. These were fixed, hardened and cut, and stained with eosin and methylene blue. Under a low power the kaolin could be seen, lying in a thin line in close apposition to the mouths of the glands. Much of the kaolin had fallen away in the course of preparation. Under a high power it was possible to make out the kaolin, sticking closely to the cells, and in some cases the cells adherent to the kaolin layer had been torn away in process of preparation.

Cultures of *Vibrio choleræ* from Guy's Hospital Bacteriological Laboratory and the Lister Institute were used throughout the following experiments in duplicate.

Intraperitoneal inoculations were made through three series of guinea-pigs to raise the virulence. The resulting cultures gave typical pure cholera reactions and were those used in the following experiments.

To broth cultures of *Vibrio choleræ* varying strengths of kaolin were added. Later, agar plates were planted from this mixture. In every strength growth was obtained, thus showing that kaolin has no bactericidal effect.

Suspensions of *Vibrio choleræ* were filtered through varying thicknesses of kaolin deposited on silk, and the filtrate planted on agar. In all cases growth occurred, thus showing that cholera bacilli can pass through kaolin.

Agar tubes were prepared with kaolin mixed in the agar in varying amounts. It was found that the presence of kaolin had no effect on the growth of the cholera bacillus.

From the above experiments it is clear that the presence of kaolin in the bowel has only a mechanical effect on the *Vibrio choleræ* itself. This mechanical effect, however, may be instrumental in sweeping out a large quantity of the vibrios, and it should be remembered in using this treatment that the disinfection of the stools is essential, also that it is quite possible that many of the patients return home as cholera carriers.

PREPARATION OF TOXINS.

Half-litre flasks of alkaline peptone water were used, incubated at 37° C. for periods of four, six or fourteen days and filtered by means of an exhaust pump through a porcelain candle. The filtrate was sterile, shown by planting on culture media. The hollow tube of the candle was scraped to remove the deposited bacilli, which, mixed with normal saline, were heated at 60° C. for an hour. Both the filtrate and the saline emulsion containing the dead bacilli were filtered through kaolin by means of a vacuum pump. No indol reaction was obtainable with the filtrates. Commercial indol, on the other hand, filtered through a kaolin bed. These results were confirmed by repeated experiment.

The fact that the substance producing the "indol reaction" is held back by the filter bed while indol solution comes through, points to the possibility that the "toxin" giving indol reactions is not a true indol, but a larger molecule which is held back by the china clay filter, while the commercial indol, which has a small molecule and is in solution, can get through.

A further series of experiments was undertaken to test the adsorptive power of kaolin for "indol," as found in the *Vibrio choleræ* toxin peptone water culture fluid.

Week old *Vibrio choleræ* toxin was taken and well mixed with equal weights of kaolin: 1 c.c. of this mixture was withdrawn every five minutes for an hour and a half and tested with Ehrlich's indol reagents. A standard colour series was made with commercial indol solutions of dilutions up to 0·0001 grm. per cubic centimetre added to Ehrlich's reagents, and it was found that after centrifugalizing 1 c.c. of kaolin and toxin suspensions at five minute intervals, no variation in the indol colour index was obtained, thus showing that the suspension of kaolin in *Vibrio choleræ* toxin cultures had no adsorptive action on the indol in the culture.

A further series of experiments was made to test the action of kaolin on ferments. Rennet and trypsin were used.

	Result
Rennet and milk	Coagulation
Rennet centrifugalized and milk	Coagulation
Rennet shaken with kaolin and milk	Some delay in action
Rennet and kaolin shaken at intervals for half an hour; centrifugalized; clear liquid added to milk	Considerable delay in action
Rennet filtered through kaolin bed and filtrate added to milk	No action

Similar experiments were performed with trypsin, and the digestion of gelatine, used as indication of action of ferment. The same results as above were obtained, and it was found that trypsin filtered through kaolin beds had no digestive action.

TOXINS.

The culture used in the following experiments was one from a fatal case of cholera in India. The vibrio agglutinated well, gave the typical reactions of *Vibrio choleræ*, and was non-hæmolytic (Greig).

Half-litre flasks of alkaline peptone water were used. These were sterilized three times at intervals to remove all spore-bearing bacilli. The flasks were inoculated with *Vibrio choleræ* before and after passage through a series of rabbits to exalt virulence. The resulting toxins were examined at four, six and fourteen-day growths. It was found advantageous to have wide-necked flasks, so that as large a surface area as possible might be presented to the air. The resulting bacillary growth was moved each day by shaking, when it fell to the bottom of the flask and a new growth appeared. To obtain a virulent culture for growing, the following method was adopted:—

(A)	Toxins were grown from *Vibrio choleræ*	No passage
(B)	,, ,, ,, ,, ...	Three passages
(C)	,, ,, ,, ,, ...	Five passages.

and finally:—

(D) Toxins were grown from the five passages *Vibrio choleræ* injected into a rabbit, with the addition of some of the four-day toxins grown from the five passages.

The four strengths of "toxic fluids" were then investigated as follows:—

(1) The toxic fluid was filtered through a porcelain candle by means of an exhaust pump. The filtrate, which was clear, was injected intravenously and intraperitoneally into two rabbits with no fatal results. Amounts up to 4 c.c were used.

(2) The deposit was scraped from the hollow tube of the candle, mixed with a small quantity of 0·8 per cent. salt solution, and then "killed" by one of three methods: (*a*) Heating at 60° C. (one hour), (*b*) exposure to Finsen light (one hour); (*c*) adding chloroform to the solution in sufficient amount to leave a clear layer of chloroform showing, then shaking the mixture (five minutes). The method of killing the vibrio appeared to have no distinctive effect on the results: the "toxins" could be heated at 60° C. to dryness and yet retain their virulence. This "killed" deposit was then injected intravenously into rabbits: 2 c.c. was fatal, the time varying with the strength of the toxin.

(3) The above deposit was then ground in a bacillary mill to break up the bacilli, mixed with 0·8 per cent. saline, and again filtered through the porcelain candle.

(4) The filtrate was found fatal to rabbits if 2 c.c. were injected intravenously.

(5) The deposit was also fatal to rabbits, being more rapid in its action than the filtrate.

(6) The addition of kaolin to any of the fatal toxic fluids destroyed their toxic properties.

GENERAL CONCLUSIONS.

The action of kaolin is twofold: (1) Mechanical; (2) adsorptive.

(1) *Mechanical.*—Such large quantities of kaolin as are used in the treatment of cholera, almost fill the bowel, and the passage of this mass through the bowel must enclose and carry with it a very large number of bacilli. Kaolin has no bactericidal effect, and this fact calls for energetic action in the destruction of fæces in all cholera cases treated by this method. The fact that the kaolin forms an adherent coating to the walls of the bowel point to its usefulness in ulcerative forms of colitis, though in these cases the rectal method of administration in the form of enemata and long tube lavage would be preferable owing to the possibilities of errors of digestion arising, after long administration, from the adsorptive properties of kaolin for ferments.

(2) *Adsorptive.*—This, the chief function of kaolin, is very characteristic—its extremely fine state of division promotes that end.

From the above experiments it is clear that, at least in the case of cholera and probably in diphtheria, ptomaine poisoning, bacillary diarrhœa, summer diarrhœa and general toxic conditions, kaolin has a wide range of use.

In the case of cholera, the first result of its administration is the cessation of vomiting. This seems to be due to the adsorption of toxic bodies in the upper alimentary tract. This is followed by the cessation of the diarrhœa and consequent loss of fluid caused by the presence in the bowel of irritant substances of a toxic nature. These, being adsorbed by the kaolin, cease to act as an irritant, and consequently the improvement of the patient is rapid and maintained.

The presence of a layer of kaolin on the walls of the intestinal tract appears to act in part as a filter bed preventing the transmission of toxins to the patient.

The adsorptive action of kaolin does not seem to be chemical. Professor Bayliss[1] has pointed out that kaolin is an electro-negative colloid, whose sign may become changed by allowing it to absorb ions of opposite sign to itself. This apparently occurs in the small intestine.

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[1] Bayliss, "Principles of General Physiology," p. 72.

I am indebted to Professor Russ and Mr. Clark for the following fact (experiments were made after Hardy's method, *Journal of Physiology*, xxxiii, p. 289): Cultures of *Vibrio choleræ* in an alkaline medium gave a definite electro-negative sign.

The adsorption of cholera toxins by the kaolin may be explained by the electrical reaction between the two, and the failure of the toxin to reach the circulation may be explained by the electrostatic attraction of the suspensoid kaolin for the cholera toxin, which thus forms one component of a Helmholtz double layer.

Professor Bayliss has pointed out that sodium chloride diminishes electro-negative charge, in accordance with Gibbs' principle; this may be the explanation of the difference observed between cases of cholera which have had saline injections preceding the kaolin treatment and those treated by kaolin only.

I am greatly indebted to Professor Eyre, of Guy's Hospital, for his kind help in the bacteriological experiments.

"THE SUCCESSFUL TREATMENT OF LEPROSY BY INJECTIONS OF SOLUBLE PREPARATIONS OF THE FATTY ACIDS OF CHAULMOOGRA AND OTHER OILS, AND ITS BEARING ON THE TUBERCULOSIS PROBLEM," by Sir LEONARD ROGERS, C.I.E., M.D., F.R.S.

This paper, read at a meeting of the Section, April 19, is printed *in extenso* in the *Practitioner*, August, 1921, pp. 77-101 (with references).

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Section of Tropical Diseases and Parasitology.

President — Sir LEONARD ROGERS, C.I.E., M.D., F.R.S., I.M.S.

Report of the Government Bacteriologist, British Guiana (F. G. Rose, M.B.), to the Tropical Diseases Research Fund Committee for the Period January, 1919, to March, 1920.[1]

(1) THE INCIDENCE OF FILARIASIS IN BRITISH GUIANA.

(i) HOSPITAL statistics in a country where infection with *Filaria Bancrofti* is so widespread are apt to be misleading, not only because a large number of the patients in the wards will be suffering from the results of past or present infection, but because the ubiquity of the mosquito carriers and the almost general absence of mosquito nettings undoubtedly leads to the infection of a great many previously uninfected from their neighbours in the wards.

(ii) Some evidence of this institutional infection was afforded by the examination of the blood of some sixty men quartered together, many from different parts of the country where filariasis is believed, on good grounds, not to exist, the results of which showed 60 per cent. to be infected, although the percentage for Georgetown, which is undoubtedly by far the most heavily infected centre, is in the neighbourhood of 25.

(iii) However, as it was a matter of impossibility to examine by night the blood of a sufficient number of the non-hospital population on which to base any accurate calculation, the following bases have been adopted, as seeming to afford a more or less high degree of accuracy.

(A) *Clinical Manifestations of Infection with* Filaria Bancrofti.

(iv) The following percentage table is compiled from observations made in 1883 on the inmates of the Lunatic Asylum by Grieve, in 1896 on the patients in the Public Hospital, Georgetown, by Conyers and Daniels, in 1908 on the patients of the Public Hospital, Georgetown, by Wise, and in 1920 on the patients of the Public Hospital, Georgetown, by the writer. The numbers of the persons examined are unfortunately not available, except for the year 1920, when 371 persons underwent examination.

TABLE I.—ELEPHANTIASIS ONLY.

	Race	Sex	A	B	C	D
			1883	1896	1908	1920
(1)	East Indians	Male	0·6	0·9	1·2	0·0
(2)	,, ,,	Female	0·0	5·0	0·8	0·0
(3)	Blacks of British Guiana and West Indian islands	Male	4·6	7·4	7·6	2·5
(4)	,, ,, ,, ,,	Female	7·2	15·0	9·3	8·8
(5)	Coloured of British Guiana and West Indian islands	Male	27·2	10·9	25·8	5·3
(6)	,, ,, ,, ,,	Female	20·0	42·4	29·8	4·8
(7)	Portuguese	Male	0·0	13·0	2·3	21·4
(8)	,,	Female	50·0	46·0	24·6	37·5
(9)	All above	Male	3·9	5·4	5·2	3·4
(10)	,,	Female	7·4	19·2	15·4	7·1

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[1] At a meeting of the Section, held November 30, 1920.

The Portuguese, especially the Portuguese women, it will be seen, retain their priority of place, and, generally speaking, there is no ground for the popular impression that this condition is now more prevalent than in bygone years.

(v) The next table, columns A and D, shows the percentage occurrence of all filarial diseases, including filarial groin-glands, chyluria, lymphangitis, epididymitis, filarial abscess, elephantiasis, &c. These observations were made by Wise in 1908 and by the writer in 1920 on the patients in the Public Hospital, Georgetown. Column B shows the percentage of children in the primary schools of Georgetown found by the writer in 1918 to be suffering from clinical filariasis; column C gives comparable figures for the children from outlying country districts in the County of Demerara. The figures in columns B, C and D are based on the examination of 3,383, 1,001 and 371 persons respectively.

TABLE II.—CLINICAL FILARIASIS (ALL CONDITIONS).

	Race	Sex	A 1908	B 1918 M. & F.	C 1919 M. & F.	D 1920
(1)	East Indians	Male	3·4	—	—	1·6
	,, ,,	...	—	11·4	12·2	—
(2)	,, ,,	Female	2·6	—	—	6·2
(3)	Blacks of British Guiana and West Indian islands	Male	15·8	—	—	23·1
	,, ,, ,, ,, ,,	...	—	34·3	26·1	—
(4)	,, ,, ,, ,, ,,	Female	24·5	—	—	17·8
(5)	Coloured, British Guiana and West Indian islands	Male	28·0	—	—	26·3
	,, ,, ,, ,, ,,	...	—	16·5	17·9	—
(6)	,, ,, ,, ,, ,,	Female	32·6	—	—	35·7
(7)	Portuguese	Male	14·2	—	—	35·7
	,,	...	—	16·9	29·0	—
(8)	,,	Female	32·3	—	—	50·0
(9)	All above	Male	14·8	—	—	18·6
	,,	...	—	25·3	21·2	—
(10)	,,	Female	25·6	—	—	23·1

(vi) Generally speaking, about 5 per cent. of the patients in the Public Hospital, Georgetown, suffer from elephantiasis, while about 20 per cent. of these patients suffer from this or some other manifestation of filariasis.

(vii) Approximately 25 per cent. of the primary school children in Georgetown, and 20 per cent. of those in the country districts of the County of Demerara show some filarial manifestation.

(viii) Of the different races, the Portuguese and mixed races share pre-eminence among the adults, while the blacks are the chief sufferers among the children.

(ix) Of the two sexes, the females suffer more.

(x) Table III shows the age-incidence of this group of disease taken from a series of 500 cases.

TABLE III.

Age-groups	1-10	11-20	21-30	31-40	41-50	51-60	Over 60
Percentages ...	7·7	29·7	31·9	13·9	12·0	4·4	0·7

(B) *The Incidence of Infection with* Filaria Bancrofti *as evidenced by the presence of Microfilariæ in the Peripheral Blood.*

(xi) Table IV shows the percentage of patients in the Public Hospital, Georgetown, found to be infected with *Filaria Bancrofti* by Conyers and

Daniels in 1896 and by Wise in 1908. Column C shows the percentage of persons examined indiscriminately by the writer from 1919 to 1920, as occasion offered, some after magic-lantern lectures, some from Onderneeming Industrial School, and many others taken at random from normal members of the population, numbering in all 351.

TABLE IV.—INFECTION WITH *Filaria Bancrofti.*

	Race	Sex	A 1896	B 1908	C 1917-20
(1)	East Indians	Male	6·4	5·4	14·2
(2)	,, ,,	Female	6·6	6·2	—
(3)	Blacks of British Guiana and West Indian islands	Male	13·0	10·2	24·8
(4)	,, ,, ,, ,, ,, ,, ,,	Female	24·0	16·8	26·0
(5)	Coloured, British Guiana and West Indian islands	Male	14·2	18·3	27·3
(6)	,, ,, ,, ,, ,, ,, ,,	Female	24·0	16·8	21·4
(7)	Portuguese	Male	16 6	16·4	15·4
(8)	,,	Female	25·0	24·8	16·7
(9)	All above	Male	10·8	9·7	19·5
(10)	,,	Female	20·1	17·3	23·3

(xii) The recent figures on the whole show an increase on the figures for 1896 and 1908. It is clear, at any rate, that there has been no reduction in the number of persons infected.

(xiii) These tables show that infection with *Filaria Bancrofti* is widespread in the County of Demerara, and especially in the City of Georgetown and its vicinity, that it attacks all races, but particularly the Portuguese, although the figures for infection and for its clinical manifestations do not appear to be correlated, the black and mixed races showing the highest percentage of infection, that these manifestations are found in the female sex in greater proportion than the male, and are at their minimum in the earliest and latest decades of life, gradually increasing from childhood until they attain their maximum incidence in young adult life, between the ages of 21 and 30.

(II) AN INVESTIGATION TO DETERMINE THE USUAL MOSQUITO CARRIERS OF *Filaria Bancrofti* IN GEORGETOWN.

(xiv) Manson ("Tropical Diseases," 1918, p. 691) mentions the following species as potential carriers of *Filaria Bancrofti: Culex fatigans, Mansonia uniformis* and *titillans, Anopheles maculipennis, Myzomyia Rossii, Myzorhynchus nigerrimuis, minutus,* and *funestus, Pyretophorus costalis, Cellia argyrotarsis, Stegomyia pseudoscutellaris* (*Stegomyia fasciata* probably occasionally). Of these species *Stegomyia fasciata* and *Culex fatigans* are extremely common in Georgetown, while *Cellia argyrotarsis* and *Mansonia titillans* are occasionally met with.

(xv) The expedient was adopted of securing mosquitoes from infected houses all over the town during the months of November and December, 1918. This was rendered possible by the willing co-operation of the Medical Officer of Health for Georgetown, Dr. Wishart, who kindly allowed his staff of Sanitary Inspectors to assist in the work.

(xvi) The mosquitoes were caught by means of a wide-mouthed glass tube open at one end, with a plug of cotton wool at the closed end, which was kept moistened with chloroform. The open end was tightly stoppered when not in use.

(xvii) The mosquitoes were brought to the laboratory as soon as possible after capture, identified and dissected.

(xviii) In all 1,500 female mosquitoes were thus dissected, of which 237 were *Stegomyia fasciata*, 105 *Cellia argyrotarsis*, 27 *Mansonia titillans*, and 1,131 *Culex fatigans*.

(xix) Although the other mosquitoes were all obtained from buildings which contained numerous infected members of the species *Culex fatigans*, only one infected *Stegomyia fasciata* was found, and none of the other species was found infected save *Culex fatigans*.

(xx) Approximately 7·4 per cent. of all *Culex fatigans* were found to be infected with *Filaria Bancrofti*.

(xxi) Thus, *Culex fatigans* appears to be the only carrier of *Filaria Bancrofti* in the City of Georgetown of any practical importance.

(xxii) The common breeding-places in the city are already well-known, but no effective attempts have yet been made to eradicate them.

(III) THE HISTOLOGY AND BACTERIOLOGY OF FILARIAL LESIONS.

(xxiii) Wise showed that the majority of the deep intramuscular abscesses so frequently met with in this Colony are associated with *Filaria Bancrofti*, and are due to infection with the pyogenic cocci, especially *Streptococcus pyogenes*.

(xxiv) The writer has in previous reports brought forward evidence to show that this secondary bacterial infection plays the chief part in the other inflammatory lesions associated with filariasis.

(xxv) The material used in the present investigation has been collected from fifty cases of deaths from intercurrent disease, and consists of (1) lymphatic glands, both healthy glands, and glands which have been the seat of filarial infection and of recurrent lymphangitic attacks; (2) testicles which had been the seat of "filarial" orchitis; (3) elephantoid tissue; (4) pus from "filarial" abscesses; (5) fluid from the retroperitoneal lymphatic spaces in "filarial" peritonitis. The results of these investigations are embodied in the succeeding paragraphs.

(xxvi) *The Pathology of the Filarial Gland.*—The following methods were used in the preparation of sections: Some of the material from each case was hardened in (1) 10 per cent. formol solution, some in (2) alcohol and some in (3) Zenker's fluid. After dehydration, the material was imbedded in paraffin, cut with a rocking microtome, and stained with Delafield's hæmatoxylin and eosin, eosin and methylene-blue, Van Gieson's mixture, Unna's polychrome methylene-blue, and Mallory's acid fuchsin stain.

(xxvii) *Macroscopic and Microscopic Appearances.*—These are well-known and need not be described in detail here. Speaking generally, one may say that the "filarial" lymphatic gland is of two main types, the varicose gland and the gland which is the seat of solid enlargement. The varicose gland may itself be the seat of inflammatory processes, while the simple enlarged gland may be the result of acute or of chronic inflammation. It is from the acutely inflamed gland that, by using suitable culture-media, one can, in 90 per cent. of cases, obtain a pure culture of streptococcus from the greyish juice expressed, or, when suppuration has occurred, streptococcus and either *Staphylococcus albus*, in the majority of cases, or *Bacillus coli*, *Bacillus pyocyaneus* or other organisms. The characteristics of the gland which has been the seat of recurrent inflammatory attacks is the marked reduction of the cellular content of the follicles, and the generalized fibrosis. Calcareous deposits are found not rarely in connexion with these glands.

(IV) ARNETH'S REACTION IN FILARIASIS AND OTHER CONDITIONS.

(1) Arneth, in drawing attention to the variations in the lobulation of the neutrophil leucocytes of the blood, pointed out that in infectious disease there occurred a well-marked "shift to the left" or increase in the relative numbers of the unilobular and bilobular forms, while in pulmonary tuberculosis the shift to the left was proportional to the extent of the disease. Since then numerous papers have appeared on the subject, the latest, so far as the writer knows, being that by Treadgold.[1] The method of expressing the reaction adopted in this paper is that of Von Bonsdorff,[2] who adds all the lobes of all the nuclei together.

(2) The following are Von Bonsdorff's and Treadgold's figures for the healthy male and female in temperate climates, placed in juxtaposition with the average figures obtained by the writer in British Guiana.

TABLE V.

	Women						Men					
	1	2	3	4	5	Total	1	2	3	4	5	Total
Von Bonsdorff ...	12·5	44·85	33·55	8·35	0·75	240·0	8·0	38·4	40·2	12·4	1·0	260·0
Treadgold ...	12·4	42·4	38·6	6·0	0·6	240·0	9·4	39·6	40·8	9·6	0·6	252·6
British Guiana ... (averages)	27·2	43·0	25·2	3·8	0·8	208·0	20·6	41·5	30·3	6·7	0·8	225·7

These figures were obtained after preliminary counting for purposes of practice of over sixty blood-films. It will be seen that the female count is definitely higher than the male, as in Von Bonsdorff's and Treadgold's figures.

(3) Table VI (*see* p. 6) shows the figures and the individuals from which these averages were obtained. Race and age (between 10 and 60) appeared to have no influence on the nature of the count.

Many conditions wide-spread in British Guiana, such as heavy infections with intestinal parasites, &c., may exert some influence on the count, and further investigation is necessary before attributing the high count to the external temperature. Formal figures for British Guiana were fixed between the extreme limits of 180 and 240 for women and 200 and 260 for men.

(4) *The Effect of Filariasis on the Index.*—The following are cases with embryos of *Filaria Bancrofti* in the night-blood, some of whom had never had any attacks, while the rest had had attacks in the past (*see* Table VII, p. 6).

Thus simple filarial infection appears to exert no influence on the index.

---

[1] Treadgold, *Lancet*, 1920, i, p. 699.

[2] A. Von Bonsdorff, "Beiträge zur Klinik der Tuberculose," 1913, v, Supplement-Band.

TABLE VI.

Males.

Case	Count					
	1	2	3	4	5	
(1) Ex-captain, B.E.F., aged 25, in excellent health, pure white race, two months in British Guiana, living in non-malarial locality	16	40	30	12	2	244
(2) Male, mixed race, aged 36, native of British Guiana, in good health, no recent malaria, normal blood-count	21	39	35	5	—	224
(3) Ex-private, B.E.F., aged 28, good health, pure white race, served in the Army three years, returned to British Guiana six months ago, no recent malaria, blood-count normal	25	43	24	8	—	215
(4) East Indian, laboratory assistant, aged 18, good health, no recent malaria, slight eosinophilia, probably due to ascaris infection, no evidence of filariasis; born in British Guiana	15	46	32	6	1	232
(5) Chinese, aged 20, good health, no history of malaria or filariasis, no embryos in blood, differential count normal; born in British Guiana	22	34	36	8	—	230
(6) Pure white race, aged 45, excellent health, no recent malaria; about ten years in British Guiana	19	44	32	5	—	223
(7) Pure white race, aged 46, good health; about twelve years in British Guiana	26	45	23	3	3	212
Average ...	20·6	41·5	30·3	6·7	0·86	225·7
Females.						
(1) Aged 14, born in British Guiana, pure white race, blood-count normal, excellent health	28	42	26	3	1	207
(2) Aged 32, black, born in British Guiana; good health, no malaria for many years, blood-count normal	29	46	20	5	—	201
(3) East Indian, aged 30, born in British Guiana; good health, normal blood-count, no malaria	24	40	27	6	—	215
(4) Mixed race, aged 40, born in British Guiana; good health, no recent malaria, blood-count normal	27	35	32	5	1	218
(5) Pure white race, aged 36, in British Guiana three years, non-malarial locality; no history of malaria, blood-count normal	28	49	21	—	2	199
Average ...	27·2	43	25·2	3·8	0·8	208

TABLE VII.

	Females						Males					
	1	2	3	4	5		1	2	3	4	5	
(1)	29	46	20	5	—	201	13	43	32	9	3	246
(2)	20	39	34	7	—	228	23	48	25	4	—	210
(3)	24	43	27	6	—	215	21	37	36	5	1	228
(4)	17	40	34	8	1	236	11	36	41	12	—	254
Averages	22·5	42	28·75	6·5	0·25	220	17	41	33·5	7·5	1	234

(5) The following were the indices in various undoubted filarial conditions, embryos being in some cases absent from the blood (*see* Table VIII, p. 7).

(6) Though the average count among the females is within the arbitrary limits fixed (180 to 240), it will be seen that there is a definite tendency to a shift to the left. One case, however, occurred, of doubtful filarial origin, for which reason it has not been included, in which there was a tendency to a right shift, with a count of 236. The males also show a distinct tendency to a shift to the left.

TABLE VIII.

Females.

Case	Arneth Index						Normal or otherwise
	1	2	3	4	5	Total	
(1) Filarial mastitis (several attacks in the past)	47	36	14	3	—	173	Shift to left
(2) Filarial lymphangitis (attack subsiding)	36	36	24	4	—	196	Normal limits
(3) Filarial lymphangitis (subsiding) ...	34	45	19	2	—	189	,, ,,
(4) ,, ,, ,, ...	27	51	20	2	—	197	,, ,,
(5) ,, ,, ,, ...	36	43	17	4	—	189	,, ,,
(6) ,, ,, (subacute) ...	31	47	19	3	—	194	,, ,,
Average ...	35·2	43	18·8	3	—	189·7	
Males.							
(1) Filarial lymphangitis (slight) ...	32	33	29	6	—	209	Normal count
(2) ,, ,, ...	30	41	23	6	—	205	,, ,,
(3) Elephantiasis, with synovitis of knee-joint, diagnosed as of filarial origin	15	33	38	11	2	249	,, ,,
(4) Filarial abscess	53	36	10	1	—	159	Shift to left
(5) Filarial lymphangitis (acute stage)...	41	46	9	3	1	177	,, ,,
(6) ,, ,, (subsiding) ...	49	36	13	2	—	168	,, ,,
(7) ,, ,, (acute stage)...	44	33	18	5	—	184	,, ,,
(8) ,, ,, (both legs, acute, marked œdema)	33	43	22	2	—	193	,, ,,
(9) Filarial lymphadenitis (after twenty-four hours)	76	20	4	—	—	128	,, ,,
(10) Filarial lymphadenitis and lymphangitis (subsiding)	42	34	20	3	1	187	,, ,,
Average ...	41·5	35·5	18·6	3·9	0·4	185·9	

(7) The following table illustrates the counts in typical cases of lymphangitis of filarial origin, at different stages of the disease. All the cases were mild cases, subsiding within one week of onset.

TABLE IX.—ARNETH INDICES.

Time from onset to time of examination—

24 hours	2 to 3 days		4 days to 1 week		1 week or less after subsidence	
Male	Males	Females	Males	Females	Male	Females
(1) 128	(2) 187	(6) 217	(8) 177	(10) 181	(14) 249	(15) 236
	(3) 184	(7) 194	(9) 205	(11) 189		(16) 231
	(4) 209			(12) 173		(17) 191
	(5) 203			(13) 196		

(8) The next table contrasts the indices in severe and in mild cases, taken at about the height of the attack.

TABLE X.—ARNETH INDICES.

Mild				Severe			
No.	Male	No.	Female	No.	Male	No.	Female
1	249	1	236	1	210	1	189
2	230	2	231	2	160	2	150
3	198	3	191	3	193	3	196
4	247	4	216	4	159		
		5	215	5	168		
				6	210		
Averages	231		217·8		183·3		178·3

(9) The cases chosen were cases from which all other conditions which might have led to an alteration in the count could safely be excluded.

(10) High Arneth indices were also found in many other varieties of filarial disease, but these have not been included on account of the co-existence of malaria and other conditions which are known to cause a shift to the left.

(11) *Conclusions.*—(i) A simple infection with *Microfilaria Bancrofti* has no effect on the Arneth index in man. (ii) When clinical symptoms occur, the Arneth index almost invariably shows a shift to the left, although, very rarely, a pronounced shift to the right may be found. (iii) This shift is also found in cases of filarial œdema and of elephantiasis, when not of very long standing, and bears a relation to the severity and the duration of attacks.

(12) Not only are these results consistent with the assumption that pathological symptoms in these cases of filarial infection are invariably due to the influence of pathogenic bacteria, since it is well known that septic infections cause a shift to the left, but this change in the index obviously supplies a useful guide in prognosis and treatment, and is now being so used by the writer. The co-existence of filarial infection with a high index points to the probability of an early onset of symptoms and is an indication of the advisability of prophylactic inoculation.

(V) THE LEUCOCYTES OF THE BLOOD IN FILARIASIS.

(1) In attempting to obtain a true blood-picture in these conditions, every possible care has been taken to eliminate all other co-existing conditions, such as malaria, ankylostomiasis, &c., so frequently found in British Guiana, which might have vitiated the results obtained.

(2) The normal differential count in British Guiana and the differential count in simple filarial infection without pathological manifestations. It has been widely stated that an eosinophilia is found in many cases of filariasis, and the accuracy of this statement is undoubted. As eosinophilia occurs, however, in cases of ankylostomiasis, trichinosis and other conditions which may co-exist, it seemed advisable to attempt to obtain a series of counts in (i) normally healthy persons in the Colony, and (ii) similar individuals who are only abnormal in presenting microfilariæ in the peripheral blood.

(3) The following table gives the results obtained: (1) Differential leucocyte-counts of thirteen specially selected healthy persons, free of helminth and all other infections, all of some years' residence in British Guiana, and all between the ages of 15 and 45.

TABLE XI.

No.	Male				No.	Female			
	Lymphocytes	Large mononuclears	Polymorphonuclears	Eosinophils		Lymphocytes	Large mononuclears	Polymorphonuclears	Eosinophils
1	26·0	10·5	53·0	9·0	1	43·0	12·5	42·0	2·5
2	32·0	10·5	55·5	1·5	2	26·0	8·5	62·5	2·5
3	40·5	7·5	40·5	11·0	3	27·0	6·5	63·5	2·5
4	48·0	6·5	39·5	5·5	4	32·5	9·5	54·0	3·5
5	23·0	12·5	55·0	9·5	5	43·5	7·0	44·0	4·5
6	31·5	11·0	51·5	1·0	6	18·2	13·6	62·8	5·2
					7	32·7	9·0	58·0	0·3
Average	33·5	9·75	49·2	6·25		31·8	9·5	55·3	3·0

(4) It was found, by performing a large number of control-counts, that a careful count of 300 leucocytes left a very small margin of error, and some of the above figures are based upon these numbers. The majority, however, are based on counts of 500 white cells. The male count of eosinophils, as will be seen, is almost invariably higher than the female. The count of eleven in Case 3 among the males was obtained from the blood of a healthy Scotsman, with no trace of disease or worm-infection, who had resided in the Colony, with intervals of long leave, for some ten years. The following table shows similar counts obtained in four males presenting no symptoms of filarial infection, and in every respect normal, save only for the presence of *Microfilaria Bancrofti* in the nocturnal peripheral blood.

TABLE XII.

Males.

No.	Lymphocytes	Large mononuclears	Polymorphonuclears	Eosinophils
1	19·0	9·5	63·0	8·5
2	15·0	12·5	67·0	4·0
3	23·5	11·0	64·5	0·5
4	26·5	10·0	54·5	9·0
Average	21·0	10·75	62·25	5·5

(5) In the case of the women examined, it was not possible to rule out altogether infections with intestinal parasites. All, however, were, apparently, normally healthy persons except for the presence of microfilariæ in the blood-stream.

TABLE XIII.

Females.

No.	Lymphocytes	Large mononuclears	Polymorphonuclears	Eosinophils
1	49·0	4·5	36·0	10·0
2	27·5	10·5	52·0	10·0
3	32·0	9·0	52·0	6·5
4	18·0	10·0	62·0	9·5
Average	31·6	8·5	50·4	9·0

(6) Thus, while the males show none, the females, as a whole, show a slight increase in the relative proportions of the eosinophil cells, which may possibly be due to other causes. The number of cases is small, but it seems doubtful, from the above results, whether simple filarial infection has any effect whatever upon the differential count.

(7) The hæmoglobin-index and the numbers of red and white corpuscles present in 1 c.mm. of the blood in cases of filarial infection were also investigated and showed little deviation from the normal.

(8) Leucocyte counts are given below in cases of filariasis with lymphangitis, orchitis, and other similar conditions frequently found associated with this infection. These investigations were undertaken to ascertain whether there might emerge from a comparison of large numbers some composite picture such as, for instance, a relative polymorphonuclear increase, which might be expected if these conditions were of a purely inflammatory nature, due to infection with pyogenic organisms. They were taken at different stages of attacks, as will be seen from the table following.

(9) *Differential Leucocyte Counts in Clinical Filariasis.*—The normal proportions of leucocytes are generally given as: Lymphocytes, 10 to 25 per cent.; large mononuclear, 5 to 10 per cent.; polymorphonuclear, 65 to 75 per cent.; eosinophils, 2 to 4 per cent. It will be seen that the normal figures for this country given above differ in the relative increases of the mononuclear cells,

large and small, and of the eosinophils, at the expense of the polymorphonuclear neutrophil cells. Whether these phenomena are the results of abortive attacks by the malarial parasite and mild degrees of intestinal parasitism it is hard to say, but, if these differences are borne in mind, it will be found that the stages of all these inflammatory filarial attacks show a constant balancing as between the lymphocytes and the polymorphonuclear cells, so marked, indeed, that it becomes of some significance in prognosis. The blood has been taken in all cases midway between meals and at the same time of day.

(10) To take first cases uncomplicated by recent malaria and with a normal percentage of the large mononuclears :—

Table A.—Cases showing Increase in Lymphocytes at the Expense of the Polymorphonuclears.

No.	Nature of case	Lymphocytes	Large mononuclears	Polymorphs	Eosinophils
1	Acute lymphangitis, left leg, subsiding well	32·0	9·0	52·0	6·5
2	Acute mastitis and axillary lymphadenitis subsiding well	27·5	10·5	52·0	10·5
3	Chronic lymphadenitis and lymphangitis with elephantoid œdema, duration ? three months	48·0	6·5	37·5	5·5
4	Slight attack of lymphangitis a few days before examination	44·5	6·5	36·0	11·0
5	Blood taken three weeks after recovery from moderately severe attack of lymphangitis and lymphadenitis (groin)	33·0	10·0	50·5	6·5
6	Subacute lymphadenitis (three months' duration) ...	47·0	11·3	27·8	10·8
7	Filarial abscess (closing up)	38·5	8·5	46·5	6·5
8	Lymphangitis (acute), right and left legs, elephantiasis five years' standing, three days or so after attack of one week's duration	37·7	5·7	46·3	8·3
9	Filarial orchitis, four days' duration, recovery almost complete	33·0	6·0	51·0	9·0
10	Taken four weeks after an attack of lymphangitis of the thigh	36·0	10·0	43·3	10·7

Table B.—Cases showing Increase in the Polymorphonuclears at the Expense of the Lymphocytes.

No.	Nature of case	Lymphocytes	Large mononuclears	Polymorphs	Eosinophils
1	Filarial abscess (in process of formation)	21·3	6·0	71·0	1·0
2	Acute lymphangitis, severe attack, blood taken on the fourth day of the attack ; no abscess formation	7·0	4·5	88·0	0·5
3	Acute lymphangitis, about the third day of attack ...	18·6	10·0	70·6	0·6
4	Acute attack of lymphangitis and lymphadenitis, lasted over three weeks ; taken ten days after onset	16·0	7·5	74·0	2·5
5	Filarial lymphangitis with abscess formation ; free discharge of pus present	11·0	12·0	72·5	3·5
6	Severe attack of lymphangitis, taken one week after onset ; subsiding, but slowly	18·0	10·0	62·0	9·5

Table C.—Cases in which the Balance seemed to be fairly held.

No.	Nature of case	Lymphocytes	Large mononuclears	Polymorphs	Eosinophils
1	Blood taken two months after acute lymphangitis ...	21·0	8·0	53·5	16·5
2	Filarial synovitis of left knee-joint, mild, subsiding ; taken one week after onset	23·5	7·0	57·5	12·0

(11) The next table (D) illustrates the same features in cases complicated by recent malaria, causing a relative increase in the large mononuclear leucocytes.

(12) Table D.

No.	Nature of case	Lymphocytes	Large mononuclears	Polymorphs	Eosinophils
1	Subacute lymphadenitis three weeks' duration... ...	32·2	18·7	46·7	2·4
2	Acute lymphangitis with abscess formation, healing well	35·8	24·2	33·8	5·4
3	Acute lymphangitis four weeks ago ; elephantoid œdema	38·0	13·5	45·0	3·5
4	Acute lymphangitis, third day of attack	12·9	16·8	64·5	5·8
5	Acute lymphangitis, arm and leg ; chyluria of two to three days' standing	17·0	18·2	60·6	4·2
6	Acute lymphangitis day after subsidence of attack ; elephantiasis, many attacks in last two months	15·5	16·5	50·0	18·0
7	Filarial mastitis, acute attack just over, two attacks in last six months	20·0	14·5	60·0	4·5
8	Synovitis, slight attack, after one week	24·0	13·3	47·0	14·3
9	Lymphangitis, subsiding ; duration one week	25·2	18·6	52·8	2·4
10	Lymphangitis, slight, two days after subsidence ...	19·5	21·5	55·5	3·5
11	Lymphangitis, one week after subsidence	20·3	19·0	48·0	11·3

(13) It will be clear from these tables that the first result of the onset of an attack is a relative increase in the polymorphonuclear cells. Favourable progress is accompanied by a relative increase in the lymphocytes, apparently at the expense mainly of the neutrophil cells. A relative increase in the lymphocytes is also found in subacute and chronic cases. A relative increase in the neutrophils is found, as might be expected, in abscess-formation, but also in all cases at and before the climax of the attack, and in severe cases for some days after subsidence.

(VI) AN ACCOUNT OF MASS-EXPERIMENTS INSTITUTED TO TEST THE EFFICACY OF VACCINE THERAPY AND PROPHYLACTIC INOCULATION IN INFLAMMATORY CONDITIONS ASSOCIATED WITH INFECTION WITH *Filaria Bancrofti*.

(A) *Preliminary Remarks and Analysis of Cases presenting themselves for Treatment.*

(1) No attempt was made to treat cases in which there was evidence of obstruction without any indications, subjective or objective, of inflammatory attacks. Such cases, however, it may be noted here are few in number, and it was found, for example, that the large majority of cases of elephantiasis, over 90 per cent., gave a definite history, upon careful inquiry, of one or more attacks of lymphangitis in the past.

(2) The following tables give an analysis of 205 consecutive cases of definite filarial disease presenting themselves for examination and treatment. Table I gives the sex-distribution.

Table I.

Males	73
Females	132
	205

(3) Below (p. 12) is given an analysis of the clinical varieties.

TABLE II.

Nature of lesion	Males		Females		Total male and female	
Recurrent lymphangitis and lymphadenitis	No.	Per cent.	No.	Per cent.	No.	Per cent.
Right lower limb	24	11·7	36	17·5	60	29·2
Left lower limb	19	9·2	40	19·5	59	28·7
Both lower limbs	22	10·7	36	17·5	58	28·2
Total lower limbs	65	31·6	112	54·5	177	86·1
Right upper limb	2	0·9	3	1·4	5	2·4
Left upper limb	4	1·9	8	3·9	12	5·8
Both upper limbs	2	0·9	9	4·3	11	5·3
Total upper limbs	8	3·7	20	9·6	28	13·5

(4) There was, in addition, one case of recurrent cervical adenitis of filarial origin. Four were cases of orchitis, two of mastitis, four presented abdominal symptoms, four had varicose glands, and two chyluria, while twenty-four presented such combinations as lymphangitis of one arm and one leg, both arms, both legs, &c. Twenty-nine of the above cases, or 14·5 per cent. gave a history of intramuscular abscess.

(5) It will be seen that the lower limb is the site of election, and it is, of course, equally well-known that the inguinal glands are by far the most frequently attacked.

(6) *Prophylactic Inoculation.*—The cases may be divided into two series, the first consisting of 167 cases treated by means of three inoculations, the first of 100 millions, and the last two of 200 millions each, of streptococci, at intervals of two weeks, over a period from October, 1918, to May, 1919. The second series of 317 cases were inoculated with a streptococcus vaccine prepared by the method of detoxication recommended by D. Thomson (*Lancet*, June 28, 1919). This series consists of cases inoculated from May, 1919, to March, 1920, two inoculations, each of 2,000 millions, being given with an interval of three weeks.

(7) Table III shows the number of cases in the first series having attacks after inoculation, and the interval of time after which attacks occurred.

TABLE III.—NUMBER OF PERSONS HAVING ATTACKS AFTER INOCULATION.

	Number		Percentage
Within one month	11	...	6·6
Within three months	35	...	21·0
Between three and six months	21	...	12·6
Between six and twelve months	19	...	11·4
None within twelve months	46	...	27·5
Number of whom there is no record	15	...	9·0
Number who have died	6	...	3·6
Number who suffered from swelling of limbs without recurrent attacks	14	...	—
Total number inoculated	167		

(8) This table and the following have been compiled from records obtained as follows: Careful notes were made in each individual case of (1) the date of each inoculation, (2) the name, age and address, and (3) the nature of the attacks with regard to severity, duration, frequency, and site of attacks. After the lapse of two years all persons who had been inoculated at least one year

before were communicated with. A questionnaire was sent to each person asking for the information which is embodied in the accompanying tables. The fifteen persons of whom there is no record could not be found by the postal authorities at the addresses given, while six persons had died of intercurrent disease.

(9) Table IV contrasts the nature of the attacks with regard to duration and severity before inoculation and after inoculation.

TABLE IV.

	Number	Percentage
Cases having milder attacks after inoculation	51	59·3
Cases in whom attacks were of the same or increased severity	35	40·7
Total	86	

(10) Of these eighty-six cases, sixty-two presented an elephantoid œdema of the affected parts. Of this number twenty-eight or 45·2 per cent. reported that the œdema had either completely disappeared or was considerably diminished, while thirty-four, or 54·8 per cent., reported that it had either remained stationary or had somewhat increased in amount. Only two cases of the latter number reported a considerable increase.

(11) Fourteen cases suffered from swelling of upper or lower limbs, not a true elephantiasis but an œdema which disappeared with rest and reappeared on moderate exercise, all of long duration, a few with no history of lymphangitis attacks, but the majority either giving such history or complaining of the dull, aching, constant pain and the "drawing-up" sensation so typical of the chronic lymphangitis and lymphadenitis associated with filarial infection. Of these fourteen cases, but two showed any diminution after inoculation; eleven remained *in statu quo*, while one reported that the swelling had increased.

(12) All who have had any experience of filariasis are aware of the extraordinary variability of the attacks both as regards severity and as regards frequency of recurrence. The writer has encountered cases, by no means rare, which have been free from attacks for periods of as long as ten to twenty years, suddenly to become once more the victims of frequent recurrences. For this reason a careful record was kept of the number of attacks suffered by each individual in the period of twelve months before inoculation and in the period of twelve months after inoculation, so that an annual average of attacks for each person could be struck, which might give useful additional information as to the efficacy of vaccine prophylaxis. The figures are as follows: Ninety persons had between them a total number of 293 attacks in the twelve months preceding inoculation, giving an annual average of 3·3 attacks per head, while sixty-three persons reported 131 attacks between them in the twelve months immediately following inoculation, giving an annual average of 2·1 attacks per head.

(13) It is clear from an examination of these tables that prophylactic inoculation has a marked beneficial effect in reducing the frequency and severity of attacks in the majority of cases. In those who have early recurrences these attacks are very frequently distinctly modified in severity, and in not a few cases the œdema diminishes or disappears along with the modification of the severity of the attacks. In cases of long-standing chronic lymphangitis and lymphadenitis, however, inoculation appears to have little or no effect.

(14) The results obtained in the second series, consisting of upwards of

300 persons inoculated after May, 1919, with larger doses of vaccine, are not as yet complete, since sufficient time has not elapsed to allow of any useful conclusions as to the efficacy of the treatment. It may be said, however, that, so far as they go, they are even more encouraging than those for the first series, and afford great ground for the conviction that a useful weapon is now available for the treatment of a disease which has hitherto been the despair of the tropical practitioner.

Many hundreds of doses of this vaccine have been prepared in this laboratory during the past year and supplied to practitioners not only in this country but to many in Dutch Guiana and in the neighbouring islands; and reports are almost unanimously in its favour.

(15) The following is a description of the mode of preparation of the vaccine now adopted in this laboratory.

(*a*) *Material used.*—Undoubtedly an autogenous vaccine would be the ideal, and has been used in a few cases by me with conspicuous success. Few, however, are willing during an attack to submit themselves to the painful process of withdrawing fluid from an inflamed lymph-gland. Cultures can, however, without difficulty be obtained from the post-mortem room, and this is the most useful source, since otherwise it is necessary to obtain them from abscesses, which are not sufficiently frequent to be a reliable source of supply, and, as will be shown later, are very frequently the result of mixed infection. In the post-mortem room pure cultures can be obtained soon after death in the dilated lymph-channels running along the spinal column in the retroperitoneal tissue, found with great frequency even when there have been no symptoms during life of retroperitoneal filariasis. It is the practice here to use relatively large quantities of material, several loopfuls, inoculated into broth and inoculated for twenty-four hours. Cultures may also be obtained by a similar method from filariated groin-glands. A few hours after death, however, at any rate in the tropics, these methods become unreliable owing to the presence of contaminating organisms.

(*b*) *Behaviour of the Streptococcus in Culture.*—No difficulty is experienced in obtaining profuse cultures in the first generation on ordinary blood-agar, blood-serum or glycerine-agar, each tube being inoculated with several loops of the broth. It has, however, been found impossible to continue subcultures beyond the third or fourth generation.

(*c*) *Preparation of Vaccine.*—The vaccine is prepared from a forty-eight hours' culture on the blood-agar, emulsified, killed at a temperature of 55° C. for half an hour, detoxicated by Thomson's method, and standardized to 2,000 millions per cubic centimetre by the method described by Major Brown (*Indian Journal of Medical Research*, vii, No. 1, July, 1919).

(*d*) *Precautions in Administration.*—Besides the general precautions necessary in the administration of all vaccines (and in this connexion attention must be drawn to the liability, in malarial countries, to the precipitation of an acute attack of malaria in malarial subjects), it has been found by experience that, if the injection be repeated after an interval of less than three weeks, the second injection is very liable to be followed by an acute attack, pointing to the existence of a prolonged "negative phase." For this reason, the practice is followed of repeating the initial dose three weeks after. Malarial attacks may be inhibited by prescribing quinine while patients are under the influence of inoculation.

These results are in great contrast to the results obtained from the infected lymph in cases of lymphangitis and lymphadenitis, which have not gone on to suppuration, in which streptococcus is almost invariably the only organism obtained, and seem to me explicable on the theory that the dammed back lymph in the channel obstructed by the filarial worm becomes comparable to an anaerobic culture-chamber in which the culture-medium is the lymph.

(16) The pus from these cases is of characteristic plum-juice colour from the admixture of blood, and in the deeper parts contains numerous fat-globules.

STREPTOCOCCUS VACCINE IN THE TREATMENT OF FILARIAL LYMPHANGITIS AND OTHER FILARIAL CONDITIONS.

(1) This vaccine, prepared as has been described, has been used very largely in filarial conditions for the past twelve months at the Public Hospital, Georgetown, in the country districts, at the other public hospitals in the colony, and by private practitioners.

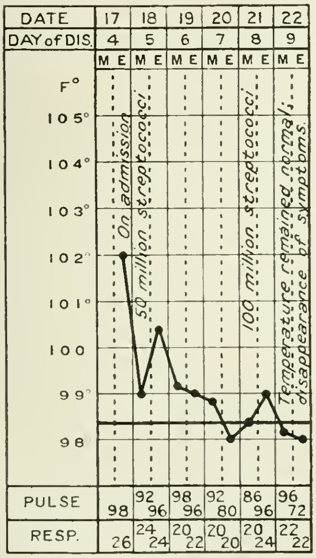

Chart I.

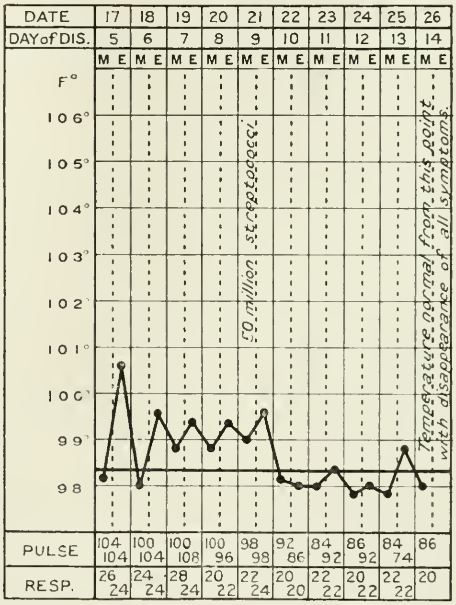

Chart II.

(2) The initial dose recommended is 2·5 c.c. of a detoxicated vaccine containing 200 millions of streptococci per cubic centimetre. If no reaction follow, 5 c.c. is given after the lapse of two full days, and this dose, under similar circumstances, is doubled after the lapse of the same period from the second dose.

(3) Except in very severe cases, it is hardly ever necessary to give more than three injections, and frequently only two are required.

(4) Owing to the variation in the duration of attacks in different cases, it is difficult to express the results of vaccine treatment in tabular form, but all those who have had experience of its use are convinced, by clinical observations, of its utility in cutting attacks short.

(5) The accompanying two temperature charts illustrate the effect of vaccine treatment. Both were cases of acute filarial lymphangitis.

DISCUSSION.

Sir PATRICK MANSON said he was much interested in the subject dealt with in Dr. Rose's paper, and especially the references to filarial periodicity, in which he had taken a considerable interest from the time of its discovery, and which had presented problems which he had failed to solve. The subject of filariasis was much more important than people, in a general way, apprehended. If someone examining the populace of London systematically, in the way Dr. Rose had examined people in Guiana, had found that 40 per cent. of the people had a parasite giving rise to a serious disease, often ending in death, he wondered what guardians of the public health would have to say. Would they take some action? He asked Dr. Rose why it was that the sanitary authorities in places like British Guiana, the islands in the West Indies, and other tropical places, had not done something towards preventing such an eminently preventable disease. The obvious question was: If preventable, why not prevented?

Colonel JAMES said he would merely ask one or two questions. First, did the sanitary authorities in British Guiana think of any other plan for reducing filariasis than destroying the mosquitoes? Dr. Rose said 20 per cent. of the residents were infected, but those who used mosquito curtains were free from infection. Was any system of notification operative there? If so, what measures followed? He did not think the eradication of the *Culex fatigans* would be difficult if the necessary money were forthcoming, especially if a good water-supply could be ensured. What was the position in Georgetown with regard to water-supply? Was it good enough to enable a campaign against *Culex fatigans* to be undertaken with any reasonable prospect of success? He understood the author to say that the infection-rate in *Culex fatigans* was 7·4 per cent.; did that rate refer only to the particular mosquitoes which he had caught in infected houses, every person in which was the subject of filariasis. 7·4 per cent. seemed to be a low rate, and some members of the Health Authority there might say the special danger to the bulk of the population could not exist. What did the author consider was the danger outside these infected houses? The infected houses could perhaps be dealt with by some definite measures, even if it were deemed impossible to get rid of the mosquitoes from Georgetown. He understood that the number of cases in which a blood-count was made was ten (five males, and five females) and that it was difficult to get cases. Why should that be? He (Colonel James) did not think conclusions could be drawn from only ten cases.

Dr. MANSON-BAHR said he was glad to learn that the author considered that the phenomenon of periodicity of filariasis was an adaptation of the micro-filaria to the habits of its host, viz., the particular species of mosquito which carried it. No doubt the non-periodic *Microfilaria Bancrofti* had a wide geographical distribution, yet its limits were definitely demarcated. He had learned from Dr. O'Connor, who was working at the subject in the Pacific Islands, that its limit in the Eastern Pacific was, in one direction, somewhere about the New Hebrides; the speaker knew that north of this line the islanders had the *Filaria nocturna* infection. whilst to the south of this line the non-periodic filaria predominated. He did not know if it were possible to have two different species of filaria in one man, one periodic, the other non-periodic, in which both the parent worm and the microfilaria had the same anatomical characteristics. It seemed that where there was a non-periodic microfilaria in existence, there was a species of mosquito, probably the stegomyia, which acted as the intermediary host of that microfilaria. That stegomyia was in the case of the non-periodic variety a day-biting species only. His own experiences in Fiji were, that the *Stegomyia pseudoscutellaris* was the intermediary for the non-periodic filaria and apparently acted as such wherever the non-periodic filaria occurred; in other words, the range of this insect and the non-periodic filaria were coterminous. This stegomyia was a more efficient host for the non-periodic filaria than *Culex fatigans;* in fact it was only a very small proportion of the latter insects he experimented with which would transmit the filaria at all. Every *Stegomyia pseudoscutellaris* with which he experimented was a favourable host for this particular filaria, and large numbers of the larval filaria could be found in the thorax. It was along those lines, namely: the suitability, or otherwise, of a particular species of mosquito, that the vexed question of periodicity of filariasis could be solved.

Professor R. T. LEIPER said that many previous workers on the subject had overlooked the importance of bacterial infections. He felt unorthodox on the subject of periodicity, and did not believe that the periodicity of the filarial embryos indicated merely adaptation to the biting habits of the intermediary. Any correlation was on the part of the intermediaries. Had there not been a selection of carrier species owing to their casual adaptation to the appearances of the filariæ in the blood by day, or by night? The rhythmical rise and fall in the number of embryo filariæ subserved a further and very definite purpose. It secured for the worm an optimum degree of infection of at least some of the mosquito carriers: thus ensuring a completion of the life cycle in certain percentage. Hyperinfection defeated the purpose of nature by bringing about the death of the intermediate host.

Dr. MEHGA asked whether Dr. Rose made observations as to the temperature and humidity while he was conducting his investigations, and if so, what were the readings?

The PRESIDENT emphasized the point made by Dr. Leiper, as to the great importance of secondary infections in these cases. For many years he had been convinced of it, and so during the last ten years he had been using a streptococcal vaccine. The results had been promising, for the febrile attacks had been definitely lessened. It was a very practical point.

Dr. ROSE (in reply) said there were several reasons for the lack of active stamping-out measures in British Guiana, but the chief one, in his view, was that public opinion had not been sufficiently aroused on the matter; even now many people regarded as a fairy tale the idea that filariasis was carried by the mosquito and even those who had been so far convinced said that it was impossible to get rid of the mosquito. Letters were frequently sent to the papers saying that it was impossible to get rid of the mosquitoes in British Guiana. As a general rule, sanitary inspectors were recruited from an undesirable class, and they were open to corruption. Many of them were so ignorant that they were unable to distinguish one kind of larva from another. There was a better type in the Government Health Department. An obstacle to reform was the Council itself, selected from the property-owning class, who much resented the idea of active measures. Prosecutions were difficult to bring about, for friendship between the defendant and a Councillor and even with the Mayor, was a bar. There was no system of notification of filariasis in British Guiana. The water supply of Georgetown for drinking purposes came from vats and cisterns, which collected rain from the roofs of the houses. Part of the water supply was obtained from pipes bringing water from rivers and creeks in the interior. The pipe-borne supply was unfit for drinking; it contained much iron, and was also a good deal polluted. The 7·4 per cent. of infected mosquitoes were drawn from infected houses, and though they might be regarded as selected houses, it would have been difficult to find a house, at least in Georgetown, which was not infected. A large proportion of the poorer houses contained infected inmates. He found it difficult to get cases of pure filariasis because, after he started the treatment by vaccines, and after it had got abroad that some work was being done to alleviate the symptoms, the laboratory was besieged by crowds who had come to seek treatment, and it was from among these people that the specimens of blood were drawn. With regard to the reason why some having the filaria had symptoms and others had not, he thought it had to do with secondary bacterial infection. He once conducted a series of investigations to determine exactly what strains of streptococci were found. It was a strain of streptococcus which was very common in fæces. As the sewage-disposal was carried out simply by pit latrines, which often overflowed, it was easy to imagine how cultures came to be present in the external air. The mosquitoes were collected in November and December, 1918; he made no observations on the temperature and the humidity of the atmosphere at the time.

Demonstration of the Technique of the Intravenous Injection of Antimony Tartrate in Bilharzia Disease.

By J. B. CHRISTOPHERSON, C.B.E., M.D.

THE treatment of bilharzia disease, by intravenous injections with antimony tartrate, is now being carried out extensively in Egypt, South Africa and elsewhere. It is also being adopted at the Egyptian provincial hospitals in special annexes; the doctors of Egypt employ it extensively in their private practices.

The term "antimony tartrate" includes potassium antimony tartrate (tartar emetic) and sodium antimony tartrate.[1] Both are colourless, stable salts which keep well in the tropics, and can be sterilized by boiling; and neither is too toxic to be used intravenously. Being readily procurable, they are well adapted for treating an endemic disease on a large scale in Africa. The sodium salt is preferred. It is less toxic and possibly as efficient, more soluble, and probably more easily assimilated by the tissues of the body than the potassium salt.

Bilharzia disease may be briefly described as the invasion of the human portal system by a trematode worm, sometimes hundreds of worms, the habitat of which is the liver. They periodically pass down the portal vein to the bladder and rectum in order to deposit ova. As the parasite is in the blood-stream, the logical way to attack it is through the blood-stream. The intravenous injection of antimony tartrate is therefore sound in principle.

Bilharzia disease, as we see it in England, is not the serious proposition it is in Egypt. Although the English cases are of interest, it is the bilharzia plague of Egypt we have mainly set out to cure, and in attempting to deal clinically with the problem of bilharzia in Egypt, we must keep two facts in mind: (1) That it is a national disease—practically the whole nation is saturated with it—therefore the remedy should be capable of being applied on a large scale. (2) That any remedy to be effective, must be capable of being easily applied in the out-stations. The intravenous injection of antimony tartrate fulfils both of these requirements. It is an out-patient procedure, and therefore thousands of patients can be dealt with every year, and the drug is convenient for use in the out-stations.

Antimony tartrate has two distinct actions in bilharzia disease—it kills the ova deposited by the worms, and it kills the adult worms. Of these two actions, by far the most important, because it is far reaching in its consequences, is the action on the ova, because it means nothing less than this, that the patient when injected, ceases to be a bilharzia spreader. Thousands of bilharzia carriers are spreading the disease broadcast in Egypt. They will automatically cease to do so if injected with antimony tartrate. In other words the disease can be cut off at its source by the remedy.

I think that the ova are killed by the antimony before the adult worms, although there is as yet no direct evidence to prove this.

Before commencing the injections, the physical condition of the patient should be investigated. Serious cardiac lesions and albuminuria, the result of renal deficiency, are the chief contra-indications to the use of antimony tartrate.

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[1] There is also pot. and ammon. antimony tartrate, which is anti-luetin. I have had no experience of this in bilharziasis. $SBO(C_4H_4O_6)_2,K(NH_4)_2$.

In Egypt another preliminary step is advisable, namely, dealing with the other intestinal parasites before commencing the injections.

Most Egyptians are anæmic, and harbour other parasites besides bilharzia. (Ankylostoma and *Hymenolepis nana* are the most common.) Fatty degeneration of important organs is, in Egypt, commonly due to intestinal parasites.

The best time to give the injection is about two and a half hours after a light meal and about two hours before the next meal, when the stomach is neither distended with food nor exhausted from hunger. The injections are given every other day, and commence with ½ gr. of antimony tartrate. The dose is increased by ½ gr. each injection, until the maximum dose of 2½ gr. is reached, then 2½ gr. are continued every other day until the course is completed. From 20 to 30 gr. are necessary; a "cure" takes as a rule, three weeks. It may be reduced to seventeen days by giving the first five injections on five consecutive days. It is not advisable to give this intensive course as a routine practice. Possibly a certain concentration of antimony in the blood is necessary before all the ova and worms are killed, and therefore the intervals between the injections should not be long.

Young people with healthy organs stand injections of antimony well, therefore it is not necessary to commence with less than ½ gr. even in a child aged 8. The maximum single dose of antimony, however, will be in proportion to age. The maximum dose for a child aged 16 and under is 1½ gr.

Dilution.—Antimony tartrate is an irritant, and a strong solution must not be injected into the veins. Half a grain of antimony tartrate diluted with 3 c.c. normal saline solution, is the strength I use; 2½ gr. should be given with 10 c.c. and intermediate quantities in proportion.

It is not necessary nor convenient to use a larger syringe than a 10 c.c. Record. The needle should be of hypodermic thickness and should be sharp—1¼ in. in length, and a platino-iridium needle is the best. All the apparatus used should be sterilized, the room suitable for an aseptic operation, and the light good. The patient should be lying down. Acetone, ether, alcohol may be used to sterilize the skin, but iodine obscures the vein. Any prominent vein may be chosen. The needle should be introduced into the lumen of the vein; it is bad practice to commence injecting until this has been ascertained beyond doubt. The same vein, at the same spot, may be used during the whole course of injections (twelve). Practically no damage is done to the vein wall by the injection, if it be carefully made.

Intravenous injections of antimony tartrate are equally efficient in vesical and in rectal bilharzia. The two men present to-night for intravenous injection both have vesical bilharzia disease. Like most cases one sees in England they are mild cases of old standing. Of Boer war cases there are about 500 now in England, drawing pensions. If they were cured, as they might be, they would be spared much discomfort and the country would save £10,000 a year.

The first case for injection to-day contracted bilharzia eighteen and a half years ago, east of Pretoria. It totally incapacitated him for five years. His age is 48. His present symptoms are: difficulty in holding his water, "frequency" at night, hæmaturia and pain in the lumbar region. He commenced having injections on November 5 and has already had 20 gr. of antimony tartrate. The injection of 2½ gr. to-night, will be the eleventh injection, making a total of 22½ gr. One more injection of 2½ gr. will complete his course of 25 gr.

The other patient contracted bilharzia in South Africa in 1900. He is aged 40 and is interesting clinically, for, he has suffered since 1914 from paroxymal hæmoglobinuria, bouts of which he gets whenever there is a north-east wind. His last attack was three weeks ago. The injection to-night will be his ninth injection: he has had in all 11½ gr. He is anæmic from his paroxysmal hæmoglobinuria. So far the injections of antimony have not set up an attack of hæmoglobinuria. He is having a full dose of 2½ gr. to-night. What is the connexion between bilharzia and paroxysmal hæmoglobinuria, I cannot say. The injection will cure the bilharzia but not the hæmoglobinuria.

The first effect of the injections in bilharzia is to aggravate the symptoms and increase the blood in the urine. Afterwards, the blood gradually disappears and the urine becomes normal after 5 gr. have been injected ; the visible red blood disappears from the urine, which, after about 20 gr. have been given in an uncomplicated case, is clear, that is if there is no cystitis, the whole of the blood has disappeared.

It is interesting to note that the ova disappear from the urine, during the injections. The antimony tartrate appears to act on the myracidia in a peculiar way—it stops the ova in their progress to the lumen of the bladder ; some few find their way through slowly, but whereas, before the injection of the antimony tartrate, healthy ova are living bodies and have machinery for automatic movement, after injection they are merely foreign bodies; this is shown in the remarkable change which takes place in their appearance. They become granular ; this change takes place notably when 10 gr. have been given, and is complete after 20 gr. When all the ova coming away are granular, injections may be stopped.

In the average case of bilharzia where there is not much damage to the bladder wall, the urine will become quite clear and normal, to ordinary clinical tests, after 20 gr. The patient has got rid of his symptoms, and to all intents and purposes he is cured after 25 gr.; he will continue however to pass granular ova periodically in small numbers at intervals for two years or longer.

In severe infections, and in long-standing cases where there are secondary organic changes in the bladder the urine will remain cloudy, and occasionally clots may be found for some time after the injections have ceased—this is due to the granulations or papillomata on the bladder wall, which bleed ; the blood clots, or shreds of papillomata, if examined under the microscope, contain ova. This does not mean that the patient is not cured. He is cured of the bilharzia, and nature is busy rectifying the secondary organic changes which have taken place.

If I am asked whether antimony tartrate cures cases of bilharzia complicated with fistulæ, organic changes in bladder and kidneys, &c., my answer is—it will undoubtedly cure the primary bilharzia disease, and destroy the worms and ova ; nature and the surgeon will then more easily cure the secondary organic changes.

At the time of the injection the pulse indicates the immediate effect of the antimony tartrate on the heart. Antimony is a cardiac depressant and must be given with care. The urine should be examined at each injection to ascertain the effect of the antimony on the ova, and also the effect on the kidneys—whether there is albumin due to renal deficiency or no. The patient's weight should be registered once a week. He should not lose weight during the course of injections. The temperature curve should remain subnormal. Small rises in temperature during the course are due to some failure in technique.

I need not discuss all the well known small incidents which occur, such as cough, metallic taste, colic, &c., during the injections, but there is one common complication which deserves mention—"rheumatic" pains in various parts of the body. These are conceivably due to the metabolism of the liver being interfered with by the antimony, waste products circulating in the blood, which should be elaborated by the liver. This explanation is supported by the appearance in the urine of uric acid crystals.

Before I conclude I will just allude to three uncommon complications which may occur during injections with antimony tartrate. They are (*a*) jaundice—indicating interference with the liver; (*b*) albuminuria—indicating interference with the efficiency of the kidneys; (*c*) certain skin complications (rashes and leucoderma)—indicating interference with the functions of the skin. When any of these occur injections should be suspended, and no permanent damage will result.

Relapses of bilharzia disease after 25 gr. of antimony tartrate have been given, in contradistinction to re-infection, are, I think, uncommon. They may occur, however, and it would appear that some broods of bilharzia worms are more resistant to antimony than others. Other drugs have been suggested as substitutes for antimony tartrate, notably emetine, colloidal antimony, stybinal—a representative of the more complicated organic derivations of antimony. Neither colloidal antimony nor stybinal has come up to expectations.

My own opinion is that emetine affects the ova, and it does not kill the adult worm. It may prove an alternative, to be used under certain conditions; but it is not a substitute for antimony tartrate in bilharziasis.

Leishmania Donovani, in Cultures, recovered from Spleen during Life and from the Bone Marrow of the Cadaver.

By J. Gordon Thomson, M.A., M.B., Ch.B.

(Director of Protozoology, London School of Tropical Medicine).

AND

J. A. Sinton, V.C., M.D., Major I.M.S.

It is probably well known to most of those present that the parasite of kala-azar was first cultivated in 1904 by Sir Leonard Rogers. This important discovery showed that the oval motionless parasites of kala-azar became herpetomonads, uniflagellate organisms when citrated splenic blood was kept at a temperature of 22° C. to 25° C. Natural herpetomonads, many of them very similar in morphology to the cultural forms of Leishmania, occur in the alimentary tracts of fleas, mosquitoes, sand flies, house flies, lice, &c. The obvious inference is to consider the cultural phases of Leishmania as the forms which occur in the insect responsible for the transmission of the disease to man. Patton (1907-08), through his work on the bed bug, showed that this insect was a possible carrier of the disease in India, but doubt exists, as in so fatal a disease, transmission experiments to human patients cannot be undertaken, and laboratory animals, although capable of being infected, are refractory to small inoculation doses. It is thus clear that although the parasite was discovered by Leishman and Donovan in 1903, and cultivated by Rogers in 1904, we still search for definite proof of the mode and spread of this deadly malady.

Since the original cultivation experiments by Rogers, many workers have attempted to find a better cultural method. In our cultural experiments the medium found to be most satisfactory is that known as "N.N.N." or Novy-MacNeal-Nicolle's medium. The composition of this is agar agar 14 grm., sodium chloride 6 grm., water 900 c.c. About 5 c.c. of this is placed in each test tube and autoclaved. The tubes are allowed to cool down to a temperature of 45° C. to 50° C., at which the agar remains liquid. About seventeen drops of fresh rabbit's blood are added to each test tube with aseptic precautions. The amount of blood added can be varied, but generally speaking it is better to add more to be certain of obtaining initial cultures. The blood is well mixed with the fluid agar by rubbing the tube between the hands, sloping it, and allowing the agar to solidify. The tubes are covered with rubber caps and placed in the incubator at 37° C. for about forty-eight hours. This serves two purposes, namely, it enables possible contamination of the tubes with bacteria to be detected, and at the same time it promotes the collection of condensation water.

THE ISOLATION OF THE PRESENT CULTURES.

The cultures shown were obtained through the courtesy of Dr. Manson-Bahr from one of his cases, an Indian from Calcutta admitted to the Seamen's Hospital for Tropical Diseases, London. Dr. Manson-Bahr punctured the spleen under general anæsthesia for purposes of diagnosis, taking strictest aseptic precautions, and a drop of the splenic blood was inoculated into four "N.N.N." tubes. In five days at a temperature of 24° C. all the tubes showed a few flagellates. Subcultures from these were made to new tubes on the fifth day. Since then the cultures have been continued to the seventh subculture over a period of over two months. It is not necessary to subinoculate so often, as active flagellates can exist at room temperature for over forty days. In order to make certain that the cultures are all right, fresh media must be made up once a week, and numerous subinoculations should be made. On several occasions we have found certain batches of media do not grow the parasites well. The agar as used by us was + 1 acid according to Eyre's scale, and rabbits' blood was added to this in varying quantities of not less than seventeen large drops to a tube.

It is obvious that a considerable amount of exact quantitative chemical experiments are desirable in order to determine the best reaction for the optimum growth of these flagellates. When the growth of flagellates is a very heavy one we can sometimes see a scum on the surface of the condensation water. In very old cultures the condensation water may almost entirely disappear, leaving a moist agar surface, and when these tubes are examined only rounded bodies may be found, and no active parasites. If however fresh condensation water is added they will sometimes revive as active flagellates and multiply rapidly.

THE VIABILITY OF THE PARASITE IN THE HUMAN BODY DURING TREATMENT WITH ANTIMONY AND AFTER THE DEATH OF THE PATIENT.

The patient from whom these original cultures were obtained during life died suddenly, and fourteen hours after death the parasites were successfully grown from the bone marrow of the rib in "N.N.N." media. Dr. Wenyon at the same time also obtained cultures, so that we have the interesting knowledge that treatment up to this time had failed to kill all the parasites, and also that they will remain viable in protected areas such as the bone marrow for many hours after death. Six cultures were made from the bone marrow, and in five days three of them at a temperature of 24° C. showed flagellates. All the cultures with the exception of one were contaminated with bacteria. A single tube remained free from bacteria, and subcultures were prepared from this. During treatment of an oriental sore with injections of tartar emetic by Dr. Newham at the Seamen's Hospital, cultures were obtained from the sore, which was showing evidence of healing.

The parasites of Leishmania, therefore, remain viable at least a considerable time after the commencement of tartar emetic treatment, and even when the patient has been dead some time.

Tumours of Gut Wall (due to *Galoncus perniciosus*), showing Relation of Helminth Infection to Bacterial Invasion of the Tissues.

By H. Marrian Perry, Lieutenant-Colonel R.A.M.C.

THE demonstration is concerned with the relation which certain helminth infections, in animals or in man, may bear to a subsequent bacterial invasion of the tissues.

The specimens shown have been derived from a leopard, *Felis nebulosa*, which died recently in the Zoological Gardens with symptoms of a hæmorrhagic enteritis simulating dysentery. Subsequent examination, however, determined the fact that the condition resulted from infection with a helminth, *Galoncus perniciosus*, and that death was occasioned by a septicæmia following bacterial infection of the tissues in the neighbourhood of the parasites.

Galoncus perniciosus is a small nematode which has been encountered on several occasions in the intestine of many of the Felidæ. The worms are found encysted in small nodules in the submucous coat of the intestine; some of these nodules are closed, whilst others present a small opening into the lumen of the bowel. In each nodule one or several worms are found lying in a mass of extravasated blood and inflamed tissue. This extravasated blood is found in various stages of disintegration. In places, the red cells have completely disappeared, and have been replaced by a dark grumous substance, resembling tar, containing channels in which are found the nematodes. In other portions of the affected tissues hæmatoidin crystals are a marked feature. In addition to the presence of mature worms, ova in various stages of development, and free larvæ, are present. The bacterial invasion of the tissues commences in the neighbourhood of the worms, and is the direct result of infection from the damaged mucous membrane of the intestine.

The pathological lesions are analogous to those noted by Weinberg in infections of monkeys with *Œsophagostomum apiostomum*, an occasional parasite of man, and the secondary bacillary invasion of the tissues occurs in a very similar manner. The contents of the submucous nodules become invaded by organisms which may cause a generalized peritonitis by rupture of a nodule into the peritoneal cavity, or a septicæmia by invasion of the blood stream.

In the case of the animal at present under consideration, a bacterial invasion of the blood stream was the result of the helminth infection. *Bacillus coli* and streptococci of the fæcal type were recovered from the heart-blood, spleen and mesenteric glands.

The post-mortem examination on this animal was made by Dr. N. Lucas, pathologist to the Zoological Society, who submitted the material to me for bacteriological investigation, and it is through the kindness of Professor R. T. Leiper, Director of the Prosectorium of that Society, that I have shown these specimens.

On the Occurrence of the Eggs of Mites in the Fæces of Miners in Cornwall and their Subsequent Development on Culture Media.

By M. Khalil, M.R.C.S., L.R.C.P., D.P.H.

(Egyptian Government Educational Mission.)

During August of this year an inquiry into the present position of ankylostoma infection in Cornwall was conducted, under the auspices of the Medical Research Council, by Professor Leiper. In this investigation I took part. A series of fæces from men engaged in the tin mines at Camborne were systematically examined with the microscope for helminth eggs. During this work I occasionally noted the presence of an egg which differed in several respects from known eggs of helminths. At the conclusion of the inquiry it was found that the egg had occurred in ten (i.e., 8 per cent.) of the 130 men investigated. In four of these cases a dead mite was also noted, while in six other cases mites alone were found in the fresh fæces.

It seemed probable that the unknown egg belonged to these mites. In no case were the mites found alive in the fresh fæces, but the contents of the "sanitary buckets" brought up at intervals from the deep mine workings were occasionally swarming with living mites. This suggested that the egg passed in the fæces was still living and attempts were afterwards made to induce the eggs to develop in the laboratory.

Fæces containing the eggs were mixed with water in a Petri dish and spread in a thin layer. Blotting paper was fixed into the upper lid of the Petri dish and then moistened with water. When closed together the Petri dishes thus formed a moist chamber. This was left at room temperature. Developmental changes slowly appeared in the eggs and after three weeks arthropod larvæ with three pairs of legs hatched out and began to feed on the fæces.

A few of these larval mites were transferred to plates of agar and of bile-salt-agar. On both these media the mites increased with extraordinary rapidity. Within ten days all stages, including adults and eggs, could be seen. So voraciously was the agar medium consumed that the bottom of the Petri dish was often exposed in places.

The mites, from the fresh fæces and from the cultures, were sent to Mr. Stanley Hirst at the Natural History Museum, who has kindly identified the eggs and adults as belonging to (*a*) *Aleurobius farinæ* De Geer, and (*b*) *Glycy-*

phagus species (?). These mites commonly occur in wheat, cheese, sugar, &c., and apparently gained entrance to the body as contamination of food. The adult forms are killed in their passage through the alimentary canal, but the eggs survive and are able to continue their development after leaving the body in the fæces.

The eggs of the two species found cannot be specifically differentiated in the fæces as they are apparently identical in size and appearance. They are regularly oval and elongated, measuring 115 μ long and 62 μ broad. The shell is thick, smooth, and with a vitreous appearance which differs from the egg-shell of ankylostoma. The contents are in an advanced stage of segmentation and usually fill the shell completely. They have a yellowish green sheen, but only when seen in fæces.

The agar cultures, after some days, become studded with curious orange-coloured masses which have the "naked-eye" appearance of colonies of bacteria. They become centres of propagation, but when they accumulate in the culture the death of the mites often follows.

Glycyphagus gives rise to various skin lesions amongst which "grocers' itch" is perhaps the best known. A drop of the culture fluid containing a large number of the mites (at all stages of development) was placed on the skin of the forearm and allowed to remain for some time, but no discomfort ensued. This negative result failed to support the interesting suggestion that the *Glycyphagus* had possibly some ætiological association with the "bunches" or boils which occur in Cornish miners, and are said to be the result of skin infection with ankylostoma larvæ. Nothing resembling these bunches has come under my notice in Egypt, where heavy and widespread ankylostoma infections occur.

On some Developmental Stages of *Ancylostoma ceylanicum* Looss, 1911.

By G. M. Vevers, M.R.C.S., L.R.C.P., F.Z.S.

(Beit Memorial Research Fellow: Assistant in the Department of Helminthology, London School of Tropical Medicine.)

Ancylostoma ceylanicum was first described from the Civet Cat of India (*Vicerricula mallaccensis*) by Looss in 1911 [1]. Two years later it was found and described from man in Bengal by Clayton Lane [2]. Since then it has been recorded on several occasions as occurring in mixed ankylostome infections of man in India and the Malay States, but up to the present there has been no inquiry into the life-history.

Recent experience has shown that *Ancylostoma ceylanicum* is a common parasite of Felidæ in India.

For my experiments, cultures of the embryos of this worm were obtained from the fæces of a clouded leopard (*Felis nebulosa*) which died last July in the Zoological Gardens, Regent's Park, and which was heavily infected. The ova hatched in the fæces after twenty-four hours' incubation at 20° C.: the embryos having the rhabditiform œsophagus characteristic of this stage. By the fifth day the first moult had taken place and the larvæ had reached the filariform or infective stage. With larvæ in this infective stage I succeeded in infecting four small kittens, both by the mouth and skin. These kittens were killed on the fourth, fifth, sixth and twelfth days after infection. By careful examination of the various organs post-mortem I was able to recover a number of young forms of *Ancylostoma ceylanicum* and from these to demonstrate that, on their way from the skin to their final habitat in the small intestine, they undergo two ecdyses or moults in the body.

Fig. 1 shows the larva in the infective stage; it is enclosed in a sheath and the mouth capsule is represented by a slight terminal indentation. It is in this stage that the embryo gains entrance to the body either through the buccal mucous membrane or the skin. Immediately on entry the second moult takes place, the sheath is lost and the embryo makes its way by the lymphatics and blood-stream to the lungs which it reaches on the third day. After passing through the lungs the larva travels up the bronchi and trachea down the œsophagus into the stomach; by this time a definite mouth capsule is formed (fig. 2). This mouth capsule is of a simple type, it opens terminally and is not provided with any teeth. In this stage the rapidly developing worm passes from the stomach to the small intestine where on the fifth day the third moult takes place.

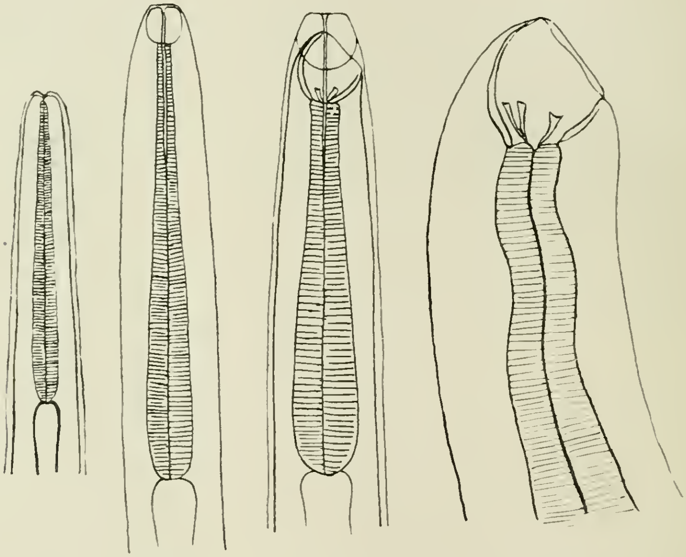

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Figs. 1-4.—Developmental stages of *Ancylostoma ceylanicum* in the definitive host.

Fig. 3 shows a worm in the act of moulting, the old mouth capsule is being pushed off, leaving the new one underneath. The mouth capsule formed by the third moult corresponds to the provisional buccal capsule described by Looss as occurring in *Ancylostoma duodenale* on the ninth day [3], and to that occurring in *Necator americanus* between the eighth and twelfth days, referred to by Stiles and Goldberger [4]. This provisional buccal capsule as shown in fig. 4 is more of the adult type although still lacking the large ventral teeth; moreover, the opening is no longer terminal but dorsal as in the mature worm. The œsophagus and alimentary canal have also increased in size and show adult characteristics, but as yet no differentiation of sexes has taken place.

So far, my efforts to determine on what day this last change occurs have failed, but there is reason to suppose that it takes place on or about the tenth day, for worms recovered on the twelfth day are found to have attained adult form. There are, however, no eggs present in the uterus of the female, and these do not appear in the fæces of the host until about the fortieth day after infection.

The diagrams are all made to scale from camera lucida drawings of mounted specimens and are magnified 400 times.

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Section of Tropical Diseases and Parasitology.

President — Sir LEONARD ROGERS, C.I.E., M.D., F.R.S., I.M.S.

PRESIDENT'S ADDRESS.[1]

By Sir LEONARD ROGERS, C.I.E., M.D., F.R.S., I.M.S.

I THANK you very sincerely for the great honour you have done me in electing me to the Presidentship of the Section of Tropical Diseases and Parasitology of the Royal Society of Medicine, a position which is greatly enhanced by the distinguished Vice-presidents you have also elected. It will be a great pleasure to me to do anything I can to ensure the success of our meetings. The full organization of our Section has been much delayed by the War, which has made its necessity all the more imperative on account of the large number of medical men, who have become interested in tropical medicine through being brought into contact with this rapidly advancing subject while on active service in the Near East and in tropical countries. The fact that we already have 115 members enrolled in our Section and that we had an attendance of over sixty members at the November meeting to organize it, clearly shows that the time is fully ripe for its birth, and that we may confidently look forward to a vigorous growth and useful work. The title of the Section has been carefully chosen to prevent confusion with the earlier established Society of Tropical Medicine and Hygiene, and I feel sure we all desire to felicitate the sister society on the honour recently done them by His Majesty the King in granting them the status of a Royal Society.

The recent bequest to the Royal Society of Medicine of the very valuable Chalmers Library of Tropical Medicine has come at a most opportune moment, and I desire to express our sincere thanks to Mrs. Chalmers for her generous gift to ensure its proper housing and display, and to condole with her on the loss of her distinguished husband just when he was about to return to this country after so many years of laborious and fruitful work in trying tropical countries.

Before proceeding to the paper of the evening I wish to take advantage of the present opportunity to say a few words on the future of research in tropical medicine mainly from the point of view of what this country and especially this, the wealthiest city of the world—much of whose prosperity is derived so largely from trade with tropical and sub-tropical countries—can and should do for the advancement of what may safely be called the most rapidly progressing and life-saving branch of medical science. We all know the great part the Schools of Tropical Medicine of London and Liverpool have played, both in training so many post-graduates and fitting them to undertake researches in various tropical countries with most beneficial results, as illustrated, for example, by the work of Castellani in Ceylon; and also in sending numerous research workers abroad for limited periods to tackle various problems such as the pioneer work of Dutton and Todd from Liverpool in the dark continent of Africa, Manson-Bahr's all too short expeditions to study dysenteries in Fiji and sprue in Ceylon, and Leiper's brilliant solution of the life-history of bilharzial parasites in Egypt, both from the London School of Tropical Medicine, to mention only a very few.

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[1] At a meeting of the Section, held February 24, 1921.

While fully admitting the value of the work done by such brief expeditions of research workers to tropical countries, my own work not unnaturally leads me to consider whether the time has not come to modify to some extent the policy hitherto pursued by our English tropical schools, which is also that of the Tropical Diseases Committee of the Royal Society, so fully justified in the past by the brilliant researches of Sir David Bruce and his fellow-workers at the very serious problem of the spread of sleeping sickness in Africa with the opening up of trade routes. Any value my own researches may have is solely due to my good fortune in being able to carry out long-continued and patient investigations in a tropical country in a laboratory in the closest possible association with a wealth of clinical material at the Calcutta Medical College Hospital, with its 600 beds, for the last twenty years, with three intervals of a few months' leave home. I was thus led to the conclusion that Calcutta presents the finest opportunities for a great school and research laboratories of tropical medicine in the world, and I have devoted much time during the last ten years to organizing such an institution, which has already commenced research work and will, by next October, be full staffed for teaching as well. To this institution a hygiene section, for which the laboratory accommodation is already provided, will be added as soon as final sanction is obtained, when the services of ten Government professors will be available with about three-fourths of their time for research. Further, the response to an appeal I issued several years ago for funds to build a special hospital for 116 beds for tropical diseases and to support additional research workers has been so liberal that at the present time, at the official rate of exchange (which unfortunately is at present considerably over the market rate) over £100,000 has been subscribed, together with such large annual contributions that, after building and equipping the hospital, an annual income of £12,000 a year is already assured for research. The largest contributions to the hospital have come from Indian rajahs and merchants, and those for research from English business men and firms, including very liberal support from Sir David Yule and Sir Dorab Tata. Seven whole-time research appointments, two of which are held by Indian research scholars, are being financed from this fund under a committee of medical men. As each worker has one or more qualified Indian assistants, the total staff will number forty-two, while the completed laboratories consist of four floors, with 220 ft. of north light, connected by a small footbridge with my former laboratory and museum, giving a total north front of 400 ft. I mention these facts to show what Calcutta has done for tropical medicine, and will only add that in my appeal I asked for money as a business proposition, and was able to persuade many of the donors that it would pay them to give money to investigate the tropical diseases such as ankylostomiasis, which so severely handicapped their labour forces. Another school on similar lines has also been organized in Bombay by my friend, Lieut.-Colonel Glen Liston, I.M.S., which, together with the four hill-top laboratories of the Bacteriological Department of the Indian Medical Service and the Pathological Laboratories of the Medical Colleges, will place India in the forefront of research in tropical medicine.

Having thus been privileged to have a share in the organization of medical research work in India on practical lines with the closest possible relationship between clinical and pathological work—an important point which I venture to think is not always sufficiently borne in mind in this country—I cannot help inquiring whether sufficient provision for similar work has yet been made in other British tropical possessions, and if not what steps are necessary to remedy such a serious deficiency. Something has, of course, been done in the last two decades, with practical results which should surely lead to world-wide further efforts in this direction, such as the discovery of the cause and means of prevention of beri-beri in the Malay States, where the Kuala Lumpur laboratory has furnished such good work; the Wellcome Laboratory of Khartoum under Balfour, from which town Christopherson's tartar emetic cure of bilharzial disease has emanated; the valuable work of the Queensland laboratory under Breinl, and that of Macfie in West Africa, where the Sir Alfred Jones Tropical Laboratory is being built at Sierra Leone. But what are they among so many save as crying appeals to the wealthy to emulate the example of such practical philanthropists as Mr. Wellcome and Sir Alfred Jones? I understand that such an important colony as British East Africa (to mention only one striking example), where white men can flourish and many of our out-of-work soldiers might well find a livelihood with some initial help from Government, has neither laboratory nor research worker, although the neighbouring Uganda Protectorate is slightly better off.

A few months ago I received an invitation to join an influential Committee for the Prevention of Tropical Diseases, but on learning from their circular that they proposed to spend £30,000 on a single expedition to a very small and rather healthy (because malaria free) West Indian Island I felt obliged to decline the invitation as I could not agree with such a policy. But I intimated that should they at any time alter their policy to one of organizing permanent research laboratories in various British tropical possessions I would gladly do anything I could to help them, and that is the policy I now desire to put forward for the consideration of those interested in the progress of tropical medicine. The Liverpool school have already given a lead in the right direction by establishing research laboratories at both Sierra Leone and at Manaos, in Brazil, and I trust that the much more wealthy City of London will not lag behind in such practical work, but will find liberal sums to enable the London School of Tropical Medicine, if they approve of the policy I suggest, to found research laboratories in British East Africa and other British tropical countries which are at present without such vitally-important institutions. If money is forthcoming, and the support of the Colonial Office can be obtained, I would suggest that annual contributions towards the support of a research worker for a limited number of years should be offered to selected British colonies on condition that the local authorities supplied a small and unpretentious laboratory to start with immediately adjacent to the largest available hospital, and I have no doubt whatever that, after five years' experience of the benefits derived from it, they will be only too glad to grant it full permanent support, thus setting free the home grant for similar use in some other country. It should be a condition of the grant that the organizing committee should have a say in the appointment of the investigator to ensure the right man being obtained for the critical first five years, which should I suggest be the shortest time any research worker should go abroad. This plan would in time assure all important British tropical possessions obtaining permanent laboratories and research workers, while it will still be possible, and occasionally advisable, to send temporary expeditions of specially qualified investigators to tackle some urgent problem due to an epidemic disease, or an especially technical problem such as schistosomiasis was but a short time ago. The old policy of trusting entirely to temporary inquiries, with heavy costs for equipment and passages, and leaving no permanent organization behind the pioneers to carry on the work they have begun, should be abandoned as far as possible.

I trust I have made it quite clear that I am not criticizing the earlier policy, which was doubtless correct in the first stages of the evolution of our home schools of tropical medicine, but I do wish to suggest, in the light of my long Indian experience, that the time has come for the further advance I have indicated. Indeed, I think this has been necessitated by the very success of recent researches in this field, including all the work done on dysenteries during the war, for now so many of the simpler problems have been solved the remaining problems of tropical medicine will require much more prolonged and detailed inquiries, including team work, such as is being provided for in the Calcutta school, the liberal public support of which would serve as a stimulating example to London philanthropists, and especially to those whose firms or companies trade with tropical countries. Their young assistants have to live in such climates exposed to unnecessary dangers to their health from the lack of the safeguards provided by research laboratories, and I appeal to their employers for support for the proposals I have ventured to bring forward.

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Section of Tropical Diseases and Parasitology.

President—Sir LEONARD ROGERS, C.I.E., M.D., F.R.S., I.M.S.

The Value of Laboratory Reports on Stools in Cases of Suspected Amœbic Dysentery, and their Interpretation by the Clinician; with a Special Note on the Diagnostic Significance of Charcot-Leyden Crystals.[1]

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INTRODUCTION.

SINCE Laveran's discovery of the malarial parasite in 1880, the essential value of the microscope in aiding, and making absolute, the clinical diagnoses of diseases of protozoal origin, has steadily increased in importance, and, in this connexion, it is our initial purpose to demonstrate the necessity of a complete and intelligent co-operation between the physician in charge of the case and the pathologist.

The need for the careful microscopical examination of suspected materials, and the importance of correctly interpreting the result of such examinations was realized many years ago by Sir Patrick Manson, when he wrote, "There are more mistakes made in the diagnosis of malaria with the microscope than, perhaps, in any similar study; on the other hand, if properly employed, it may give valuable information, leading, perhaps, to the saving of life." These remarks of Sir Patrick's need not be confined to malaria only; they are true of all diseases of protozoal origin, and it was this point of view that led him to found a school for the study of tropical diseases, a school in which facilities were developed for research in the various branches of parasitology.

The clinician, with numerous patients under his care, finds the time at his disposal quite inadequate for the personal examination of the large mass of daily routine specimens, and it therefore follows that a specialist in pathological work becomes necessary. This specialization has a distinct advantage in leading to a higher efficiency in both branches, but, nevertheless, it must not be forgotten, that each must have a thorough practical knowledge of all the factors of the case, that the parasitologist must know the clinical features, and the clinician the methods by which a diagnosis is arrived at microscopically.

The diagnosis of a typical protozoon does not present much difficulty. The atypical, however, may give rise to much confusion. For example, a student, having completed a course of study in tropical diseases, can, with reasonable exactitude, diagnose a typical four-nucleated cyst of *Entamœba histolytica*, whereas only an expert with a considerable degree of experience can be sure of a case in which uni-nucleated cysts are predominant. Special technique is required for the study of protozoa, and this must be combined with the ability to distinguish the minute morphological differences in the objects seen. It can be said with certainty that many a person has had emetine administered to him on the strength of the presence of macrophages in his stool, while, just as frequently, the drug has been withheld owing to the diagnosis having been missed.

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[1] At a meeting of the Section, held February 24, 1921.

As a general rule it may be said that in acute protozoal diseases the parasites are usually present in sufficient numbers to make the diagnosis fairly easy; in the more chronic forms, on the other hand, the parasites may be so scarce that they can only be found after a prolonged search, and sometimes they may not be found at all. The parasitologist must, in chronic cases, exercise considerable patience and examine specimen after specimen; the clinician should give due weight to the negative diagnosis of each specimen, and should show an equal persistence by seeing that his colleague is supplied with each specimen for examination as the material becomes available. In such chronic cases a brief résumé of the clinical aspect of the case is of inestimable value to the pathologist as an indication on what he should concentrate his attention.

Whenever practicable material from a suspected case should be sent before treatment is begun, since the parasite, while not being completely exterminated, may be so reduced in numbers and so changed or degenerated that the difficulties are increased one hundred fold.

Further, after a course of treatment, the clinician cannot accept as evidence of complete cure the absence of protozoa from one specimen, but must have several specimens examined at reasonable intervals.

THREE POINTS OF IMPORTANCE FOR THE PHYSICIAN TO OBSERVE WHEN SENDING STOOLS FOR EXAMINATION.

So far we have been, more or less, considering the relationship of the clinician and parasitologist from the point of view of protozoal disease in general, and now we come to the consideration of that relationship in respect to dysentery.

There are three important rules for the guidance of the clinician in sending stools for examination:—

(1) Send the whole stool when possible. This is a material aid, since the general appearance of the stool is frequently quite characteristic. Thus the parasitologist can see at a glance whether the stool is diarrhœic, semi-solid, normally formed, or constipated, and whether mucus and blood are present, and if so, in what quantity.

(2) Send the stool as soon as possible. Free, vegetative entamœbæ are greatly affected by adverse circumstances. Movement, which is so characteristic, will only occur at, or near, a temperature of 37° C. An absolutely fresh stool brought to the laboratory, may, on examination, be found to contain entamœbæ, which are already rounded up and motionless. Sometimes, by the judicious application of heat, e.g., by means of a stage containing a hot air chamber, an ordinary hot stage, or by the cruder method of putting a warm penny on the slide, movement can be re-initiated. At best the life of an entamœba, after having been passed in the stool, is a short one, in this country

as a rule not more than a few hours. With appropriate staining methods the structure of the entamœbæ can be made out for a considerable length of time, but the older the specimen, the more difficult and complicated the diagnosis.

As every one is aware cysts are much more resistant to external conditions than the vegetative forms, but, although their characteristics can usually be recognized several days after having been passed, nevertheless they, too, become degenerate, and more difficult to diagnose.

(3) When the entire specimen cannot be sent the clinician should carefully select the portion for examination. In a typical stool of amœbic dysentery one of the "sago grains" of mucus—a mere platinum loopful—may contain hundreds of *Entamœba histolytica*, whereas in the remainder of the stool the parasites may be few and far between. If blood-stained mucus is present it should always be included in the specimen.

During the period March to September, 1920, we definitely diagnosed thirty-two cases of amœbic dysentery. In twenty-three of these cases free entamœbæ were found, and in nine only were cysts found. Of the twenty-three cases in which free forms were present at the beginning, three developed cysts shortly after treatment was begun. The diagnoses were definitely established as follows:—

(1) In eighteen of the cases on the first occasion the stool was sent for examination.

(2) Ten cases were diagnosed on the second stool.

(3) One case at the third examination.

(4) Two cases at the fourth.

(5) In one case seven stools were sent for examination over a period of twenty-three days before a diagnosis was made.

The significance of these results is that the clinician must not construe a negative diagnosis on one or two occasions to indicate that his patient is not suffering from the disease, but must have the stools examined frequently over a fairly long period.

THE MACROSCOPIC DIAGNOSIS OF DYSENTERY STOOLS.

In discussing the microscopic and macroscopic appearances of dysentery stools we intend to confine our remarks to true dysentery, by which we mean either bacillary or amœbic infections.

During the progress of an acute bacillary dysentery, or an exacerbation of an amœbic dysentery, provided that the initial disease is uncomplicated, the macroscopic appearances of the stools are very characteristic. Indeed, so marked is this feature, that we now intend to describe the typical stool of each condition.

(a) *The Stool in an Exacerbation of Amœbic Dysentery.*

(1) The stool may only consist of blood and mucus. It should be noted that the general colour of the stool is a reddish-brown, or, as it has sometimes been described, chocolate shade, and not the bright red of ordinary blood.

(2) The stool may consist of mucus intimately mixed with the fæcal material, in which the mucus is seen as small masses or blobs, so aptly described as the "sago grain" appearance.

(3) The stool may be a fluid one, in which the mucus is so intimately mixed with the fæcal material as to be almost imperceptible to the naked eye. This, however, is not nearly so characteristic as the two foregoing.

(*b*) *The Stool of Amœbic Dysentery in more Latent Cases.*

Typically this is a formed stool of normal consistency, and to the naked eye presents only one feature, unfortunately not always present, viz., small glistening pin points of thick tenacious mucus ón its surface. In many of these cases the stool appears to be perfectly normal.

Needless to say the number of possible variations from the above are infinite, from the sudden passage of a quantity of pure blood from an eroded artery to a hard, constipated stool, but, so far as possible, we are describing those most frequently met with.

(*c*) *The Stool in Acute Bacillary Dysentery.*

(1) Probably the most characteristic stool is one in which fæcal matter is nearly absent, the mucus is clear and jelly-like, and is streaked with bright red blood.

(2) The stool may simulate very closely the rice-water stool of cholera, being thin, watery, and flaked with mucus.

(3) The stool may be like the above and yet contain flakes of exudate almost amounting to casts of portions of the gut, or, as sometimes happens, shreds of the mucosa, also reaching considerable proportions.

(4) The stool may be stained green from the presence of bile pigment.

(*d*) *The Stool in Chronic Bacillary Dysentery.*

No characteristic stool can be described. The condition usually consists of recurrent attacks of diarrhœa in which the stools are similar to the foregoing but are not so distinctive. The disease is milder—the stools are not so characteristic.

THE MICROSCOPIC CHARACTERS OF DYSENTERY STOOLS.

We shall now deal with the points we may expect to observe microscopically in the stools, and for ease of description, we shall mention them under the same headings as we did for the macroscopic appearances.

(*a*) *In an Exacerbation of Amœbic Dysentery.*

A stool from an uncomplicated case of amœbic dysentery presents under the microscope a picture so very distinctive that this was used by one of us (J. G. Thomson), while in Egypt during the war, as a rapid method of diagnosis when time did not permit of a prolonged search for the entamœba.

The most salient feature is the extraordinary absence of cells. There are numerous red blood corpuscles to be found in the mucus, a few columnar epithelial cells from the mucosa in varying stages of degeneration, an occasional macrophage and mononuclear leucocyte, and, most conspicuous by their absence, a very small number of polymorphonuclear leucocytes (*vide* Pl. I, fig. 1). Charcot-Leyden crystals are very characteristic, and will be discussed in detail later on.

The finding of *Entamœba histolytica* clinches the diagnosis absolutely. *Entamœba histolytica* with included red cells, if not too much degenerated, need not be confused with an endothelial cell or macrophage which has been phagocyting red blood corpuscles. Occasionally there may be some difficulty in differentiating between *Entamœba histolytica* and the harmless *Entamœba coli*, but, apart from the predilection of the former for red corpuscles as food, the nuclear structure and the cytoplasmic features of each are very characteristic. Dobell rightly lays stress on the central position of the karyosome in the nucleus of *Entamœba histolytica* as compared with the eccentric position of *Entamœba coli*, but we should like to emphasize that this, *per se*, cannot be considered as diagnostic, as, not infrequently, even in fresh specimens, the karyosome of *Entamœba histolytica* is eccentric.

(*b*) *In the more Latent Forms of Amœbic Dysentery.*

In the small pin points of surface mucus one may expect to find the same cell picture as in the mucus from a stool during an exacerbation, with this proviso that in all probability the epithelial cells and mononuclears are more degenerate, and that the macrophages and polymorphs are even scantier in number. In the formed stool we expect to find not the free forms but the cysts, and, as their characters have been so clearly described elsewhere, we do not intend to give any detailed description of their morphological appearances. We would, however, indicate the great importance of examining the stools first of all mixed with normal saline, and then with double strength Gram's iodine. If saline movement is not inhibited, and, if one considers that each protozoon has a *sui generis* mode of movement, the diagnostic value will be apparent to all, but more than this, in the case of cysts, the chromatoid bodies stand out as clear, highly refractile, bodies, and it is possible, by such means, to differentiate between the rod-shaped, round-ended, chromatoid bodies of *Entamœba histolytica* cysts, and the filamentous, sharp-pointed chromatoids of *Entamœba coli* cysts. Double strength Gram's iodine, or for that part a dilute solution of watery eosin and some other stains, is helpful because it accentuates the nuclear and cytoplasmic structure. Iodine has this advantage over other stains, that it shows the glycogen in the cyst very clearly. Charcot-Leyden crystals are also frequently found in the stools of cyst cases.

(*c*) *In Acute Bacillary Dysentery.*

The cell picture is highly characteristic. One field of the microscope will show that the mucus contains a huge number of polymorphonuclear leucocytes and frequent macrophages. There are also some mononuclear leucocytes, epithelial cells, and red blood corpuscles, but the polymorphonuclear leucocytes predominate (*vide* Pl. I, fig. 2). Compare this with the cell picture in amœbic dysentery (*vide* Pl. I, fig. 1). During the war, in epidemics, the cell picture of the stool combined with the clinical aspect of the case, was judged sufficient evidence to begin the administration of serum without waiting for the bacteriological report.

(*d*) *In Chronic Bacillary Dysentery.*

Amœbic dysentery is essentially a chronic condition—bacillary dysentery is the opposite. An acute attack of bacillary dysentery may tail off, as it were, into a more or less chronic condition. In such a state of affairs the stool is very similar to the stool in the acute stages, with polymorphs in great abundance, but in some cases columnar epithelial cells occur in great numbers.

Superimposed Infections.

Before leaving the subject of the examination of the stools, we should like strongly to emphasize one fact, namely, that a bacillary dysentery may be superimposed on an amœbic condition. We are perfectly well aware that any two, or more, conditions may be found together in the same patient at one and the same time, but, for some reason or another, this multiplicity of infections seems to be more frequently missed in protozoal infections than in almost any other form of organismal disease. We know of cases, rightly treated for amœbic dysentery, in which the patients have died of comatose malaria, and so full of parasites were they, that a blood film could not have failed to have cleared up the diagnosis. We know, too, of cases suffering from malaria, trypanosomiasis, and kala-azar, in which the amœbic dysentery was altogether missed.

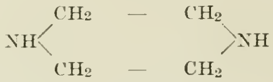
If a bacillary infection is superimposed on an amœbic condition the cell picture is that of the bacillary condition, and, if a patient suffering from a bacillary dysentery is not making the progress he ought to be making, search should be made for *Entamœba histolytica*.

PREVIOUS REFERENCES TO CHARCOT-LEYDEN CRYSTALS.

Originally these crystals were described by Charcot, about 1853, as occurring in the tissues of patients who had died of leucocythæmia. He stated that they were soluble in warm water, acids, and alkalis, but were insoluble in alcohol, ether, and glycerine, and took the form of colourless, refractile, elongated, octahedra, the so-called whetstone shape.

Leyden described similar crystals in the sputa of asthma cases.

Böttcher described crystals in seminal fluid, which are also colourless, refractile, octahedra, and are supposed to be crystals of the phosphate of spermin, derived from the decomposition of nucleins. Spermin, also called ethyleneimine, has a formula sometimes given as C_2H_5N, or as $C_4H_{10}N_2$, grouped thus:—



F. C. Wood (1917) states that the Charcot-Leyden crystals do not give the strong double refraction when examined by polarized light, as do the spermatic crystals.

In addition to having been found in the tissues of leucocythæmics, Charcot's crystals have been discovered in the freshly drawn blood of patients with leucocythæmia, and, recently, D. Thomson found them in the intestines of bed bugs fed on leucocythæmic patients, whereas they never occurred in a bug fed on normal blood, or on blood from a patient with any other blood disease.

Similar crystals have been found in bone marrow, tumours, empyema and ascitic fluid, gonorrhœal pus, and prostatic secretion, and it was supposed that these were not derived from spermin but from proteins.

Gollasch (1889) claimed that he had demonstrated that the oxyphil granules of eosinophil leucocytes might give rise to Charcot-Leyden crystals, and McJunkin (1919) wrote "Charcot-Leyden crystals . . . . stain pink with eosin. They appear to be a product of the eosinophiles, and certainly result from these cells *in vitro*." In this connexion it is interesting to note that Ciaccio claims that he has shown that these granules are chiefly composed of lipoid substance.

Stitt and Castellani, in their works on tropical diseases, both refer to the presence of Charcot-Leyden crystals in the stools of cases of amœbic dysentery. Stitt also states that these crystals are never found in bacillary infections.

E. A. Wilson (1911) found similar crystals in the stools of grouse, which he associated with the presence of parasitic infections. Castellani in describing ankylostome infections of man, states that Charcot-Leyden crystals may occur in the mucus and blood in the stools of such cases. F. A. McJunkin states that "Eosinophiles or Charcot-Leyden crystals may be demonstrable in parasitic infections of the large intestine."

In 1915, one of us (J. G. Thomson), while examining daily large numbers of dysentery stools in Egypt, noted the not infrequent occurrence in them of Charcot-Leyden crystals. After a continuous experience of the daily examination of such specimens, from 1915 to 1918, during which time over 10,000 stools were examined microscopically, the conclusion arrived at was that these crystals in the stools were practically pathognomonic of amœbic dysentery, (J. G. Thomson, 1918).

Quite independently Captain Acton, I.M.S. (1918), noted the significance of these crystals in amœbic colitis, and, in an interesting paper, comes to the following conclusions:—

(1) There is no association between Charcot-Leyden crystals and intestinal entozoa.

(2) Charcot-Leyden crystals are more commonly present in the subacute and chronic types of amœbiasis than in the acute type.

(3) They are rarely found in non-amœbic dysenteries.

(4) The association between Charcot-Leyden crystals and *Entamœba histolytica* is very high—20 per cent. of the amœbic cases.

(5) The presence of Charcot-Leyden crystals, in the absence of amœbæ, is indicative of amœbic colitis.

Acton gives an analysis of 100 cases in which Charcot-Leyden crystals were found, and eighty of these were definitely diagnosed as amœbic. This establishes the co-efficient relation of *Entamœba histolytica* with Charcot-Leyden crystals as $r = +0{\cdot}8$, and this, as Acton observes, is extremely high.

THE SIGNIFICANCE AND DIAGNOSTIC VALUE OF CHARCOT-LEYDEN CRYSTALS.

In view of the observations by other workers which have just been quoted, we have endeavoured, in the School of Tropical Medicine, to further establish the relationship between these crystals and *Entamœba histolytica*.

The crystals in the stools are of the characteristic, elongated, octahedral, shape, which has been aptly termed the whetstone shape. They vary greatly in size, and, indeed, this variation is so marked that it is impossible to give any limits. They are, however, most commonly between 3 μ and 60 μ in length, and 0·5 μ to 8 μ in breadth (*vide* Pl. II, fig. 1). The shape is, as a rule, fairly constant, but, occasionally, one meets with slight variations. Thus the ends may be rounded off instead of being produced in sharp points, or, again, others may be broken off in different situations.

In the fresh stool they are easily picked out because they are so highly refractile, and because they are coloured such a clear, faint, greenish shade. They are insoluble in tap water or distilled water at room temperature, insoluble in alcohol, ether, glycerine, xylol, formalin, Schaudinn's solution, i.e., a saturated solution of corrosive sublimate in normal saline—two parts, absolute alcohol—one part, and in a 2 per cent. solution of potassium iron sulphate in distilled water. In acids and alkalies, and in warm water, they are fairly easily soluble. Fatty acid crystals, which may be in spicules resembling

Charcot-Leyden crystals, do not dissolve readily in hydrochloric acid. Charcot-Leyden crystals stain readily with eosin, and they take up Heidenhain's iron hæmatoxylin so distinctly that they resist decolorization even after a prolonged immersion in iron alum solution.

As Acton says the crystals tend to be more numerous, and more commonly present, in the chronic forms of the disease, and he gives 20·4 as his percentage of amœbic cases showing Charcot-Leyden crystals in the stools. During the period March to September, 1920, we examined 999 stools from 207 patients in the hospital, of which thirty-two cases were definitely diagnosed as amœbic dysenteries. The number of our amœbic cases with Charcot-Leyden crystals was eight, or 25 per cent. In all probability our percentage is higher than that of Acton, because the cases we had were nearly all infections of long standing. Our figure would be much higher, as, doubtless, would be that of other observers, were the search purposely directed to finding crystals instead of merely noting their presence during the search for protozoa.

The question naturally arises here as to whether the crystals are more commonly found in stools containing cysts or stools with free forms. In our experience they occur as commonly in one as in the other, always provided that the infections are of long standing. The number of crystals present in a specimen varies immensely, and does not seem to have any relationship with the severity of the disease. The greatest number of crystals we have found were in the mucus from a sigmoidoscopic scraping of an ulcer, which we were kindly allowed to observe by Dr. Manson-Bahr and Dr. Greig, who have recently been using the sigmoidoscope as a successful means of diagnosing amœbic conditions in the lower parts of the large bowel. The crystals are also very numerous in the mucus of the amœbic stools, but it seems that the nearer it is possible to get to the ulcer the greater will be the number of crystals found. On the other hand one crystal may be found in a stool, accidentally, as it were, and a lengthy search may fail to reveal any more. On two occasions we have found Charcot-Leyden crystals within the endoplasm of free *Entamœba histolytica* (*vide* Pl. II, fig. 2). We are unable to say whether these crystals were formed *in situ*, or were ingested after formation.

The following mention of two of our cases, which are typical of many others, illustrate the great aid to diagnosis furnished by Charcot-Leyden crystals.

Case A.—The first stool from this patient was received on March 20, 1920, and in it were found neither free entamœbæ nor cysts, but numerous Charcot-Leyden crystals, and a report to that effect was rendered to the clinician. Thereafter, on seven successive occasions, no entamœbæ were found, but at the ninth examination, on March 30, 1920, numerous free, vegetative *Entamœba histolytica* were found, and thus the diagnosis was clinched.

A stool from this patient was examined on February 23, 1921, practically a year later, and, despite the fact that, since our first examination of his stool, he has had a course of emetine treatment, he still shows large numbers of cysts of *Entamœba histolytica*.

Case B.—In the second case we never found either encysted or free entamœbæ in the stools. Charcot-Leyden crystals, however, were present in large numbers. After a course of treatment the patient was examined with the sigmoidoscope and several characteristic amœbic ulcers were discovered low down in the bowel.

In addition to the above quoted cases, who were patients at the hospital, we have had opportunities of examining outside cases, through the courtesy of various physicians, and in these, also, we found the same association of Charcot-Leyden crystals with amœbic dysentery.

We can only, at present, offer a surmise as to the source of these Charcot-Leyden crystals. Of all the work already done on the subject, that of Gollasch and McJunkin, in proving that they may result from the cytolysis of eosinophil leucocytes, and that of D. Thomson, who fed bed bugs on leucocythæmic patients, and recovered the crystals from the intestines of these insects, seems to be the most significant. We are, however, inclined to the view that, in human stools, these crystals are, as it were, a by-product of the cytolytic energies of *Entamœba histolytica*, derived either from the proteids of the cytoplasm, the nucleo-proteids, or, perhaps, the lipoid substances within the cells. They may, perhaps, be the result of an excretion of the entamœba, either by itself, or in combination with some other substance within the bowel. There are two factors worth noting, first, that the envelope of a red blood corpuscle, the favourite food of the entamœba, is extremely rich in lipoid substance, and, secondly, that in no section of an ulcer of the human intestine, which we have had the opportunity of viewing, have we ever seen the crystals.

Whatever their derivation may be, we believe that their presence is due to specific action on the part of *Entamœba histolytica*, that they are never found in dysenteries of bacillary origin, and we agree with Acton that they are not found in entozoal infections of man from which the presence of *Entamœba histolytica* has been excluded; in the human stool they are diagnostic of dysentery caused by *Entamœba histolytica*.

SUMMARY.

(1) There should be close understanding between the clinician and the pathologist with regard to the diagnosis of protozoal diseases.

(2) The clinician should not construe a negative finding in one or two stools to mean that his patient is not suffering from amœbic dysentery.

(3) Considerable care should be shown in the selection of material to be sent to the laboratory for examination.

(4) The macroscopic and microscopic appearances in the stools of pure uncomplicated cases of amœbic dysentery and of bacillary dysentery are very characteristic.

(5) Charcot-Leyden crystals are probably the result of the cytolytic action of *Entamœba histolytica* on the body cells.

(6) Charcot-Leyden crystals are present in a very high percentage of cases of amœbic dysentery, and are more commonly present when the disease is of long standing.

(7) The presence of Charcot-Leyden crystals in human stools is diagnostic of amœbic colitis due to *Entamœba histolytica*.

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Dr. W. BROUGHTON-ALCOCK supported the remarks of Dr. Gordon Thomson on the value of close relationship between clinical and pathological work. In the examination of all pensioners who claimed to have had dysentery during the late war, and who were attending the Tropical Diseases Clinic, London Area, as out-patients, about 10 per cent. were found to be harbouring *Entamœba histolytica*. Repeated examinations were often necessary in healthy carriers to secure positive findings. After hospitalization and intensive bismuth emetine iodide treatment stools were often found negative for two or three weeks, but not infrequently the *Entamœba histolytica* was found soon after return of the pensioner to home life and food. His percentage of findings of Charcot-Leyden crystals was not as high as the figure given by Dr. Gordon Thomson. Where the *Entamœba histolytica* or its cyst was found it was not his practice further to search the fæces for these crystals. In view of the diagnostic value Dr. Gordon Thomson had shown should be attached to these crystals, and of the evidence he had given as to its value, he (Dr. Broughton-Alcock) suggested that it would be a help in detecting these crystals, especially when small in size, if a stain could be found to colour them in fresh as in fixed specimens, during direct routine examinations of fæces of suspected carriers. It might be worth trying a concentrated solution of old brown hæmatoxylin, pure or in combination, since this had the great practical value of staining the nuclei of amœbæ in vegetative and cystic forms in fresh preparations.

EXPLANATION OF PLATE I.

FIG. 1.—Portion of the microscopic field of film of mucus to show cell picture of amœbic dysentery. Note the free *Entamœba histolytica*, the numerous red blood corpuscles, and the paucity of other cells. Stained with Heidenhain's hæmatoxylin. (× 1,000 approx.)

FIG. 2.—Portion of the microscopic field to show cell picture of bacillary dysentery. The large number of polymorphonuclear leucocytes is very striking. Note the macrophage with the included polymorph. Stained with Heidenhain's iron hæmatoxylin. (× 1,000 approx.)

EXPLANATION OF PLATE II.

FIG. 1.—Camera lucida drawings of Charcot-Leyden crystals, showing variations in size, and the slight differences occasionally found in shape. Stained with Heidenhain's iron hæmatoxylin. (× 1,000 approx.)

FIG. 2.—Camera lucida drawing from field of mucus obtained by scraping the surface of an amœbic ulcer through the sigmoidoscope. Shows numerous red blood corpuscles, Charcot-Leyden crystals of different sizes, one mononuclear leucocyte and one polymorph, and, also, *Entamœba histolytica*, free form, which, in addition to included red blood corpuscles, has a Charcot-Leyden crystal in its cytoplasm. Stained with Heidenhain's iron hæmatoxylin. (× 1,000 approx.)

PLATE I.

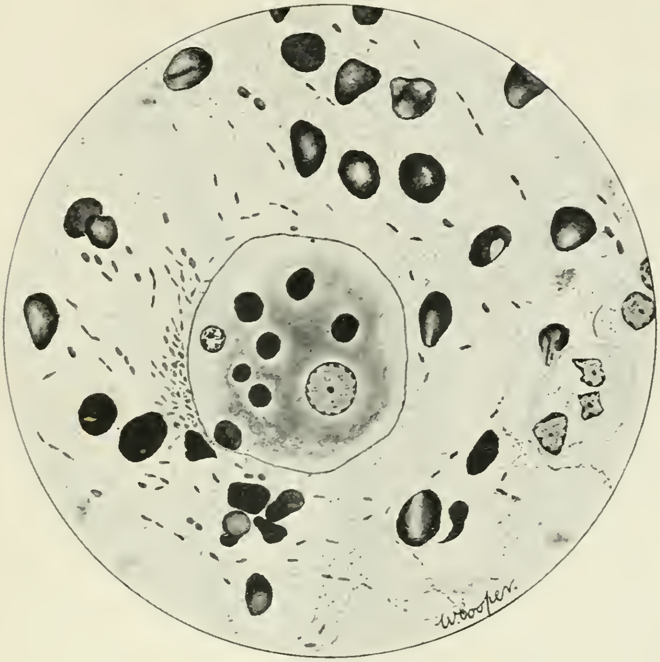

FIG. 1.

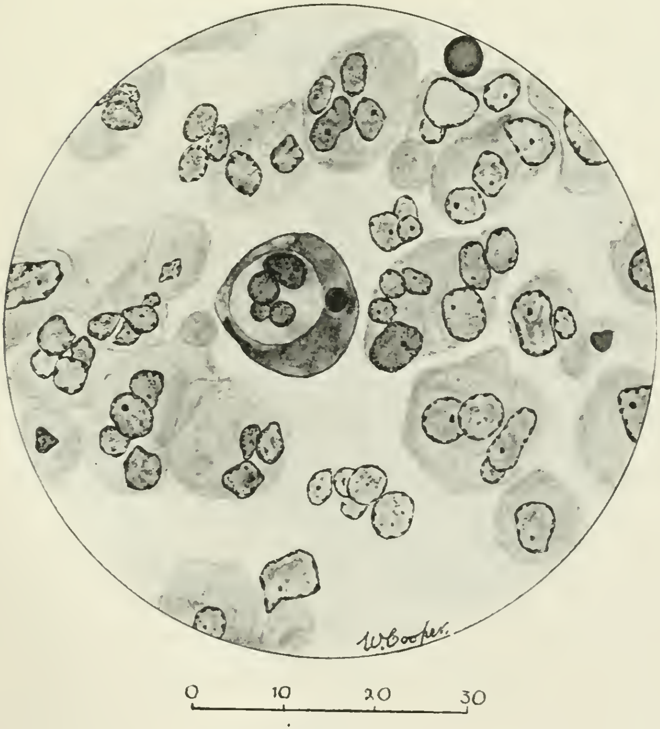

FIG. 2.

PLATE II.

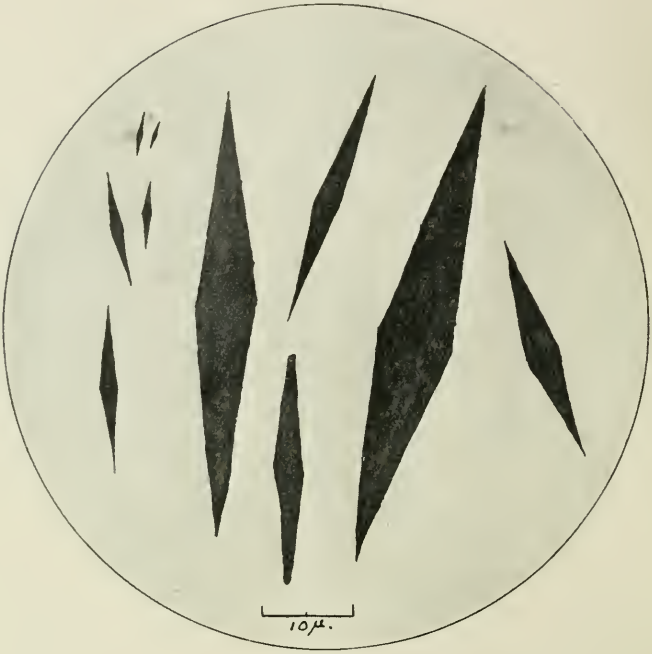

FIG. 1.

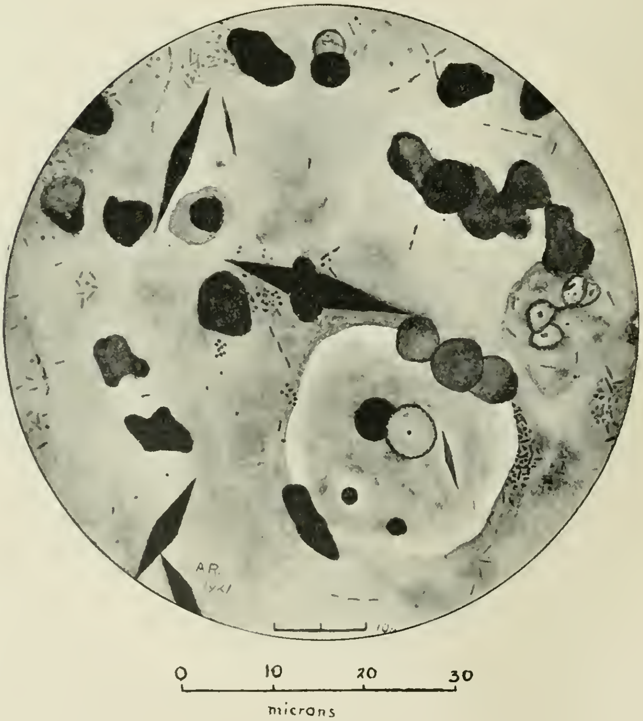

FIG. 2.

Section of Tropical Diseases and Parasitology.

President — Sir LEONARD ROGERS, C.I.E., M.D., F.R.S., I.M.S.

Laboratory Observations on Pensioners who contracted Malaria in the Late War.[1]

By W. BROUGHTON-ALCOCK, M.B.

(Director, Central Laboratory, Ministry of Pensions.)

THE following is an account of an investigation carried out on scientific lines, that has resulted from our efforts to further knowledge on the most extensive of all tropical diseases, malaria, and more particularly on the diagnosis of latent malaria in Great Britain by laboratory means. The work is a collaborative one in which my colleagues, Dr. Lucey, Dr. Fry, Dr. Roche Lynch and Dr. Haig and experienced laboratory assistants have shared. It is for me as director to report our results.

I have to thank Sir Lisle Webb, D.G.M.S., Dr. Neilson and Dr. Hill, C.C's.M.S., Dr. Rhodes, C.M.S., and Dr. G. B. Price, who have done so much to facilitate and encourage our efforts.

Collaboration with the clinician has been an important factor in furthering these researches and gratitude is extended to those who generously participated with us and have given the assistance of their clinical acumen and long previous experience of malarial cases in tropical and sub-tropical countries.

It is not for me to discourse upon administrative or medico-legal questions, nor to enter fully into the important bearing of the disease, with its lamentable death and invaliding rôle, on the conduct of the late war. I merely give you the War Office figures of cases admitted to hospital in four of the fighting areas, as these furnish some idea of the number of possible claimants for a pension, in which connexion, I may add, there were approximately 52,500 new claimants in Great Britain and Ireland as late as last year.

Mesopotamia: 1916, 680; 1917, 7,744; 1918, 10,202.
Salonica: 1916, 31,059; 1917, 71,413; 1918, 59,087.
East Africa: 1917, 58,236; 1918, 20,015.
Egypt: 1916, 1,423; 1917, 8,480; 1918, 30,241.

The first records of malaria as a disease in man take us far back into ancient times and in some of these earlier records it appears that a relationship of the mosquito to malaria was suspected, but epoch making discoveries and advances did not come until the latter half of the last century. To these we attach with a deep sense of the honour and gratitude due to them the names of Meckel, my late teacher Laveran, Golgi, Marchiafava and Bignami, Manson, Ross, Grassi, Low and Sambon, among others. Further fruitful researches have followed and others are still being carried out. So wide is the field for research on malarial problems and so many the factors to be taken into consideration in a study of this disease, that the workers in many countries who have turned their energies and abilities to it are led, at least temporarily, to research mainly upon one section of it. By making known the findings, the work of one becomes complementary to the works of others in our common purpose of furthering knowledge therein.

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[1] At a meeting of the Section, held April 4, 1921.

Mindful of my indebtedness to confrères for the assistance and advantages gained from their labours, I put forward to-night some observations gleaned from our recent work in summarized and tabulated forms and as briefly as is consistent with clearness of interpretation, so that those present may have the fuller time to give their valued opinions. I earnestly beg discussion and when a comparative line of investigation has led to different results I trust that we shall determine the reason for our differences, and come to some definite conclusions on the following two fundamental points in our discussion:—

(*a*) The diagnosis of latent malaria in Europeans who have returned from tropical and sub-tropical regions.

(*b*) The determination of radical cure.

From the opening of the Central Laboratory on October 1, 1919, I have directed the researches with especial regard to the following points:—

(1) Search for the parasites or presence of malarial pigment.

(2) Study of the white blood corpuscles, and especially the relative percentage of the large mononuclear or endothelial leucocyte.

(3) Relation of the laboratory results to the clinical findings.

Regarding No. (1) the time allotted to each stained film for search before pronouncing a negative result was fifteen minutes, save when one was encouraged to continue by such a note as "spleen enlarged" in the clinical findings which accompanied the blood film, or by the presence of a large mononucleosis. The longer examinations were further encouraged, as the only unquestionable laboratory method of diagnosing malaria in the pensioner is the finding of the parasite or the pigment formed by it. The detection of pigment, it may be added, was very rare in this series of cases. At first a thick and thin blood film of each case was examined, but before long a regular bordered and even thin film was adopted as most advantageous in routine work of such proportion.

Regarding No. (2) one of my collaborators, Dr. Lucey, will be reading an interesting and important paper on technique in blood taking, and method of enumerating the white corpuscles, and will describe the cells we group together as large mononuclear or endothelial leucocyte, and which embody the cells termed macrophage, hyaline and transitional mononuclear and monocyte of various authors, and not the large lymphocyte cell.

As to the relative percentage of large mononuclear leucocyte that constitutes an increase there is diversity of opinion, and few authors state the minimum figure. This point calls for discussion and authoritative definition. You will observe in my tables that I have compiled the findings on the basis of 10 as well as of 15 as a minimum percentage figure. In taking the lower figure I was influenced by several factors, viz., that, should the relatively large mononucleosis prove a constant in latent malaria and have a value at this figure in the diagnosis, the pensioners would not fail to be benefited in their assessment and opportunity for treatment; also that the normal percentage of large mononuclear leucocyte has quite a wide range and 10 per cent. is an exceptional finding in the film of a drop of blood taken from the finger. Response varies in the individual and an increase from a lower figure to 10 may signify as much in one individual as a response to 15 in another. Again, with the return of the soldier to a temperate zone and better conditions of life and food one finds amelioration of the disease and more readily acquired immunity in the vast majority of cases. And might the large mononucleosis be less developed in latent malaria under these more favourable conditions, and with the accompanying weakened virulence and progressive elimination of the parasite?

The basis of 15 per cent. was taken as that fixed upon by Stephens and Christophers in the tropics and now generally accepted.

These authors, from a study of the blood cell counts of a considerable number of Europeans living in the tropics, found that an increase beyond 15 per cent. of the large mononuclear forms is proof of an actual or recent malarial infection. This change, which is usually very pronounced in the apyretic periods of an attack of malaria, is, however, most frequently absent during pyretic periods. As I presume infections with one brood of parasite is implied I may state that these deductions held good in recently infected cases I examined in the Mediterranean littoral. I would only add that, following quinine treatment and subsidence of symptoms and disappearance of the parasite from the blood stream in cases that have returned home, the large mononuclear increase was not found with any constancy after the few days following a symptomatic attack.

Our work on pensioners is in fact an extension of their studies and is applied to *latent malaria, with comparatively few cases of acute symptomatic relapses, in Europeans who have returned from tropical and sub-tropical regions.* Unhappily in an out-patient clinic one cannot get blood examinations in the day to day sequence one would wish and uncontrollable factors such as unreliability of many of the pensioners in their statements, and irregularity of their visits, also handicap scientific investigations.

Amongst the many authoritative publications since the original work of Stephens and Christophers and of Kelsch, H. Vincent and Billet one finds such a statement as "This mononucleosis is observed for a long time after an attack of fever" or "In hæmatological infections such as malaria the blood picture is usually definite." I cannot say whether these statements apply to *cases of latent malaria in tropical or sub-tropical endemic areas.* The point I wish to bring forward is that they are accepted as applicable by a majority of our clinicians in Great Britain and their diagnosis of latent malaria is not infrequently influenced by the presence or absence of a relative large mononucleosis. Justification for this is not supported by our findings; and, as the question is one not only of scientific interest but of great practical bearing on treatment and on medico-legal assessment of pensions, I earnestly beg your opinion upon it to-night.

The following paragraph which bears specially on this point is quoted from the *Bulletin de la Société de Pathologie exotique*, 9 Février, 1921, p. 105, by Dr. J. Rieux, Chef du Laboratoire Val-de-Grâce (the Military Hospital of Paris), who has been investigating similar cases to those comprising my series but in the French Army: "Or, l'étude de la formule leucocytaire des anciens paludéens de ceux qui font l'objet de cette étude, montre que monocytes, lymphocytes et éosinophiles reviennent au taux normal en même temps que disparaissent du sang les hématozaires et que cessent les accès fébriles. Seul le taux des neutrophiles accuse pendant plusieurs mois, pendant un an et même davantage après cette période, une diminution toujours notable."

TABLE IA. 801 CASES.

Showing the Blood Cell Findings, Associated Clinical Condition present, and Proportion in which Parasites were found in Relation to a Clinical State.

Clinical condition	Number of cases	BLOOD FINDINGS: Relative increase of large mononuclears 10 per cent. and over (*a*)	BLOOD FINDINGS: Relative increase of leucocytes 31 per cent. and over (*b*)	BLOOD FINDINGS: Combined relative increase of large mononuclears and leucocytes (*c*)	BLOOD FINDINGS: No relative increase of large mononuclears or leucocytes	RELATED CLINICAL CONDITIONS: LIVER: Enlarged	RELATED CLINICAL CONDITIONS: LIVER: Normal	RELATED CLINICAL CONDITIONS: ANÆMIA: Present	RELATED CLINICAL CONDITIONS: ANÆMIA: Absent	RELATED CLINICAL CONDITIONS: HEART: Abnormal	RELATED CLINICAL CONDITIONS: HEART: Normal	MALARIAL PARASITES: *Plasmodium vivax*	MALARIAL PARASITES: *Plasmodium falciparum*	MALARIAL PARASITES: *Plasmodium malariæ*	MALARIAL PARASITES: No parasites found
SPLEEN		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.			Per cent.
Enlarged	127	41·7	46·5	18·1	29·9	15·7	84·3	26·8	73·2	4·7	95·3	14·2	—	—	85·8
Normal	674	36·8	46·7	16·1	32·6	4·8	95·2	8·9	91·1	2·4	97·6	1·3	—	—	98·7
LIVER						SPLEEN Enlarged	SPLEEN Normal								
Enlarged	52	34·6	53·8	19·2	30·8	38·5	61·5	17·3	82·7	7·7	92·3	3·9	—	—	96·1
Normal	749	37·8	46·2	16·3	32·3	14·3	85·7	11·4	88·6	2·4	97·7	3·4	—	—	96·6
ANÆMIA								LIVER Enlarged	LIVER Normal						
Present	94	34·0	46·8	10·6	29·8	36·2	63·8	9·6	90·4	9·6	90·1	11·7	—	—	88·3
Absent	707	38·0	46·6	17·2	32·6	13·1	86·9	6·1	93·9	1·9	98·1	2·3	—	—	97·7
HEART										ANÆMIA Present	ANÆMIA Absent				
Abnormal	22	27·3	54·5	18·2	36·4	27·2	72·8	18·2	81·8	40·9	59·1	4·6	—	—	95·4
Normal	779	37·8	46·5	16·4	32·1	15·5	84·5	6·2	93·8	11·0	89·0	3·4	—	—	96·6

The figures contained in column (*c*) are included in figures contained in columns (*a*) and (*b*).

Abnormal signifies: Tachycardia, Hæmic murmur, Dilatation, D.A.H.

TABLE IC. 819 CASES.

Showing the Clinical Observations, Blood Cell Findings, and Proportion of Parasites found in Relation to the Period of Time since the First Appearance of Symptoms.

Period since first attack	Number of cases	CLINICAL OBSERVATIONS							BLOOD FINDINGS				MALARIAL PARASITES			
		Clinical condition	SPLEEN	LIVER	Clinical condition	ANÆMIA	Clinical condition	HEART	Relative increase of large mononuclears 10 per cent. or over (*a*)	Relative increase of leucocytes 31 per cent, or over (*b*)	Combined relative increase of large mononuclears and leucocytes (*c*)	No relative increase of large mononuclears or leucocytes	*Plasmodium vivax*	*Plasmodium falciparum*	*Plasmodium malariæ*	No parasites found
6 months	18	Enlarged Normal	Per cent. 38·9 61·1	Per cent. 5·5 94·5	Present Absent	Per cent. 27·7 72·3	Abnormal Normal	Per cent. 11·1 88·9	Per cent. 55·5	Per cent. 38·9	Per cent. 11·1	Per cent. 16·7	Per cent. 33·3	—	—	Per cent. 66·7
1 year ...	48	Enlarged Normal	35·4 64·6	4·2 95·8	Present Absent	20·8 79·2	Abnormal Normal	4·2 95·8	33·3	54·2	12·5	25·0	28·3	—	—	91·7
2 years ...	133	Enlarged Normal	15·0 85·0	3·7 96·3	Present Absent	14·3 85·7	Abnormal Normal	5·3 94·7	37·7	49·6	16·6	29·3	4·5	—	—	95·5
3 years or over	620	Enlarged Normal	14·5 85·5	7·3 92·7	Present Absent	10·5 89·5	Abnormal Normal	2·1 97·9	37·9	45·4	16·7	33·4	2·7	—	—	97·3

The figures contained in column (*c*) are included in figures contained in columns (*a*) and (*b*).

Abnormal signifies: Tachycardia, Hæmic murmur, Dilatation, D.A.H.

TABLE IIA.

Recorded area of inspection	Total number of cases examined	TOTAL POSITIVE FINDINGS				CASES FOUND POSITIVE ON ONE OCCASION ONLY			CASES FOUND POSITIVE ON MORE THAN ONE OCCASION	
		Number	Type of parasite			First examination positive, subsequent examination negative	First examination negative, subsequent examination positive	Positive on first examination and not returning for subsequent examination	Same type of parasite found	Different type of parasite found
			Plasmodium vivax	*Plasmodium falciparum*	*Plasmodium malariæ*					
(1) Palestine ...	1,384	27	27	—	—	12	9	5	1	—
(2) Mesopotamia	1,616	117	115	2	—	57	29	21	10	—
(3) India ...	2,872	152	148 (a)	5 (a)	1 (a)	67	28	35	21	1
(4) Egypt ...	1,548	39	39	—	—	22	6	8	3	—
(5) S. Africa ...	112	1	1	—	—	1	—	—	—	—
(6) E. Africa ...	1,298	23	23	—	—	10	7	5	1	—
(7) W. Africa ...	146	1	1	—	—	—	—	—	1	—
(8) Balkans ...	11,951	209	207	1	—	99	46	47	17	—
(9) Malta ...	19	1	1	—	—	1	—	—	—	—
(10) Italy	138	12	12	—	—	4	6	2	—	—
(11) Asia Minor ...	82	4	4	—	—	2	1	1	—	—
(12) S. Russia ...	198	41	39 (b)	2 (b)	1	21	3	11	4	2
(13) Syria ...	89	4	4	—	—	3	1	—	—	—
(14) Persia ...	79	7	6	—	1	5	—	2	—	—
(15) Turkey ...	76	5	5	—	—	2	—	3	—	—
(16) W. Indies ...	8	1	1	—	—	1	—	—	—	—
(17) Aden ...	1	1	1	—	—	—	—	1	—	—
(18) Gallipoli ...	218	3	3	—	—	2	—	1	—	—
(19) England ...	100	3	3	—	—	2	1	—	—	—
(20) Cyprus ...	1	1	1	—	—	1	—	—	—	—
(21) France ...	136	1	1						—	—
(22) Germany ...	4								—	—
(23) Indefinitely recorded	6,164	128	120	4	1				—	—
Totals ...	28,270	777	759	14	4					

TABLE IIB.

Positive Findings and Period after Return of the Pensioner to Residence in England.

	1 month	2 months	3 months	4 months	5 months	6 months	7 months	8 months	9 months	10 months	11 months	12 months	13 months	14 months	15 months	16 months	17 months	18 months	19 months	20 months	21 months	22 months	23 months	24 months	25 months	27 months	28 months	29 months	30 months	31 months	33 months	36 months	39 months	41 months	43 months	51 months	59 months
(1)	—	—	2	3	4	3	2	2	2	1	1	4	1	—	—	—	—	—	—	2																	
(2)	6	2	13	7	16	13	14	9	14	4	5	4	4	1	1	—	1	—	—	—	—	—	1	—	—	—	—	—	1								
(3)	*P.f.* 3 *P.v.* 2	—	*P.f.* 1 *P.v.* 7	5	5	18	12	16	12	18(a)	13	*P.f.* 1 *P.v.* 1	8	2(a)	9	1	1	1	—	—	1	—	1	2	—	—	1	—	—	—	—	—	—	—	—	—	1
(4)	3	1	4	5	3	2	2	5	2	2	1	1	4	3	—	—	—	—	—	—	—	—	—	1	—												
(5)	—	—	—	—	—	—	—	—	—	—	—	1																									
(6)	—	—	1	2	3	—	1	2	—	2	—	1	1	—	—	—	1	3	—	—	—	—	1	—	—	2	—	—	2	1							
(7)	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—												
(8)	4	2	7	13	19	15	17	23	23	21	10	16	10	1	10	*P.m.* 1 6	1	1	1	1	—	—	1	—	1	1	—	1	—	—	1	1	—	1	1		
(9)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1				
(10)	—		—	3	1	—	—	—	2	3	—	2	—	—	—	—	—	1																			
(11)	—	1	—	—	1	1	1	—																													
(12)	1	—	—	1	7	6	8	2	3	1	5(b)	1	1	2																							
(13)	1	1	—	—	1	—	1																														
(14)	—	—	2	—	1	1	—	—	—	—	—	1	1	—	—	1																					
(15)	—	1	—	1	2	—	—	—	1																												
(16)	—	—	—	—	—	—	—	1																													
(17)	—	—	—	—	—	—	—	—	—	—	—	—	1																								
(18)	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	
(19)	—	—	1	—	—	1	1	—																													
(20)	—	—	—	1	—	—	—	—																													
(21)	—	—	—	—	—	1	—	—																													

(a) Case shows triple infection– *Plasmodium vivax*, *Plasmodium falciparum*, and *Plasmodium malariæ*.

(b) Case shows double infection—*Plasmodium vivax* and *Plasmodium falciparum*.

Plasmodium vivax unless otherwise stated.

Regarding investigation No. (3) reference should be made to Tables IA, IC and ID. In these I must first note that the leucocytolytic action of quinine may be eliminated as a factor in the white cell formulæ found. The findings are from examinations made at the first visit of the pensioner-claimant to the tropical diseases clinic. The clinical observations are those of three very experienced clinicians, who have unremittingly and enthusiastically collaborated and given us with each film a record of the case. Tables were primarily prepared monthly but no distinctive differences were noted and all cases from June, 1920, to February, 1921, are embodied. It was not possible to make total white cell counts. Related findings of lymphocytes are added, and the percentage of polymorphonuclear cells may be deducted.

I have given only the table worked out on the figures of a relative increase of large mononuclear cells as the figure of 10 per cent. or over. Space does not permit of publishing also a table with the figure of 15 per cent. or over, which has also been prepared. The number of cases showing this higher percentage is of course smaller, but the conclusions to be drawn from it do not contradict those to be drawn from that based on the 10 per cent. figure.

Table IA is to be considered with Table IC.

An outstanding conclusion to be drawn from these tables and one which concerns us to-night, is that a relative increase of large mononuclear or endothelial leucocyte is not a constant factor in latent malaria even when the most reliable diagnostic clinical sign, an enlarged spleen, is present and the clinical diagnosis of latent malaria is obvious. Noteworthy also is the fall in the percentage of findings of the parasite and of clinical signs, enlargement of spleen, presence of anæmia, cardiac abnormality as time lengthened from the date of the first attack of malaria.

Table II has been prepared with a twofold purpose: (*a*) To record the number of cases examined from each endemic area and proportion of positive findings therein; and (*b*) to glean some knowledge as to the persistence of the parasite, and any regional variation of the plasmodium in this persistence, in the body after their return to England. The findings grouped under (*b*) are further interesting when compared with those made by Dr. Rieux on pensioners in France. In his conclusion he states: "Il nous paraît qu'on est dès lors autorisé à dire que les manifestations vraies du paludisme, chez des malades soustraits par le retour en France à toute infection nouvelle et bien traités, durent environ une année et qu'après elle la guérison de la maladie est faite."[1]

The last point with which I have to deal, and I shall touch upon it in only a general way, is the value of the test for quinine in urine in the control of out-patients, a test with which are associated the names of Ramsden and Lipkin, and Nierenstein among others. The moral influence on pensioners who know that their veracity as to taking quinine can be questioned is striking. This laboratory test has been found very reliable and I only wish to-night to make further known its advantages to the clinician, as upon our findings he has been able to maintain more regular and efficient treatment of pensioners needing it, and aided in weeding out malingerers. We have modified the technique of the direct Tanret's or Mayer's test by acidulating the urine to not more than 2 per cent. with acetic acid as this has been found by Roche Lynch to give a positive finding in a much higher dilution of quinine in the urine, especially if the urine be previously alkaline. Our period of time taken for practical application of the test to all pensioners is three to eighteen hours after the official dose of 10 gr. of quinine is taken orally. The taking of repeated daily doses prolongs this limit.

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[1] *Bull. de la Soc. Path. exotique*, 1921, xiv, p. 108.

To give you an idea of the number of pensioners who are taking the quinine supplied to them, our figures for March, 1921, on the three to eighteen hours' limit are as follows, the dose being 10 gr. of quinine sulphate in solution with acid sulphuric dil.: Positive, 291 : negative, 134.

Our gratitude is due and expressed to the Commissioner and Assistant Commissioner, London Region, Ministry of Pensions, and to the D.C.M.S., Tropical Diseases Clinic, for their unremitting interest and assistance in the carrying out of this work.

Observations bearing on the Reliability of the Large Mononuclear Leucocyte Count as an Aid to the Diagnosis of Malaria.[1]

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THE diagnosis of latent malaria has become a matter of pressing importance in this country since the war, owing to the number of demobilized soldiers who have returned from the East, where they contracted the disease, and are now claiming pensions on the score that they still suffer from relapses. The difficulty in diagnosis is increased by the fact that, now that they have returned to their own homes and civil life, they cannot be kept under such close observation, and blood films made at the time of questionable attacks. Instead, they report themselves at intervals to one of the many malarial clinics dotted about the kingdom. More often than not, they turn up with no clinical signs of malaria, and blood films made at the clinic show no parasites. It is important from every point of view that a correct diagnosis should be made. From the point of view of both the man and the State, if he has malaria he should receive the proper treatment and adequate pension; if he has not malaria, but some other disease which is simulating it, that disease should be recognized; and from the point of view of the State, if he has nothing the matter with him, the country should not be put to the unnecessary expense of treating and pensioning him. It is in cases where clinical signs are lacking, and the malarial parasite cannot be found, that the large mononuclear leucocyte count has been so much relied upon by many clinicians to settle the diagnosis. If these cells are up, the man is assumed by them to have malaria. It has long been a recognized fact that at some stage during an actual attack the large mononuclears *may* be increased, but the questions which chiefly concern us at present are:—

(1) How long after an attack do they remain up?

(2) During long quiescent periods (weeks, months) between the attacks, does latent malaria cause at any time an increase in these cells?

(3) If a decided increase in the large mononuclears is found in a man, who at some previous period is known to have had malaria, are we necessarily to assume from this that he is still suffering from malaria in a latent form, or some other disease associated with an increase of these cells?

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[1] At a meeting of the Section, held April 4, 1921.

This paper deals with the last question, and arising out of it is another—Can you ever in a perfectly normal individual get a decided increase in the large mononuclear leucocytes?

The answer, according to the investigations given below, is—Yes, you *may* get such an increase if the drop of blood is taken from the *ear*, and if the importance of certain technical details in the taking of it is not appreciated.

Moreover, such a drop from a normal person, if it shows a decided increase in the large mononuclears, gives an entirely false picture of the blood in his general circulation. Any number over 12 per cent. I hold to be a decided increase. In the course of the examination of some thousands of blood films at this laboratory it was observed that those taken by certain clinicians appeared to be more frequently associated with a mononuclear increase than those taken by other clinicians. This was particularly the case with Sir Ronald Ross's and Colonel G. P. T. Groube's films. It seemed a point worth investigating. I therefore asked Colonel Groube after he had taken a blood film from a pensioner to send him to me, when I also took a film. We each pricked the lobe of the ear. Sometimes I pricked the same lobe as he did, and sometimes the other. The blood counts were all done by myself, and the same method of counting employed throughout—viz., 100 cells were counted on each horizontal edge where the polymorphs and large mononuclears tend to accumulate, and 200 cells in the body of the film where the lymphocytes tend to remain, that is 400 cells in all.

Chart I shows the results in six consecutive cases. It will be seen that whereas in Cases I, II, and V Colonel Groube's film showed a marked mononuclear increase, mine gave a normal count. In Case IV, both films showed a marked increase, mine being the higher. Case III showed a normal, and Case VI a high and approximately equal count in both films.

CHART I.

Film taken by	Percentage of large mononuclear leucocytes					
	Case I	Case II	Case III	Case IV	Case V	Case VI
Colonel Groube	**29**	**18**	9·5	**22**	**36**	**19**
H. C. L.	9·0	7·5	7·0	**34**	10	**18**

For brevity's sake the percentages of the other different types of cells have not been included in the chart. When there was a percentage increase in the large mononuclears it was at the expense of both polymorphs and lymphocytes, generally more marked in the case of the polymorphs. Large lymphocytes are not included under the term "large mononuclear leucocyte." So-called "transitionals" are included.

The fact then became established that two people each taking a blood film from the ear of the same man at the same time, both films being counted by the same observer, could produce very different results in the relative number of white cells present. As the explanation seemed to lie in some difference in technique, experiments were carried out to test this.

Chart II shows an experiment to test the influence, if any, of: (1) The needle used for pricking the ear; (2) the spreader used for making the film; (3) the method of spreading.

CHART II.

Part pricked by Colonel Groube	Needle used	Spreader used	Film spread by	Percentage of large mononuclears
Lobe of right ear	Colonel Groube's rough blunt needle	Colonel Groube's	Colonel Groube	**37·7**
		Colonel Groube's	H. C. L.	5·7
		H. C. L.'s	Colonel Groube	4·5
		H. C. L.'s	H. C. L.	5·0
Lobe of left ear	H. C. L.'s bright sharp needle	Colonel Groube's	Colonel Groube	**25·2**
		Colonel Groube's	H. C. L.	4·5
		H. C. L.'s	Colonel Groube	4·0
		H. C. L.'s	H. C. L.	5·0

Colonel Groube had always used a particular needle, which had become rough and blunt, whereas I used a bright sharp one. We each had our own special glass spreaders, which were narrower than the slides on which the films were made, so as to leave a double horizontal edge. His method of making the film was to pull the spreader with the blood in front of the edge, whereas I always pushed it with the blood following the edge. Both ears of a pensioner, supposed to be suffering from chronic malaria, were pricked by Colonel Groube, his needle being used for one ear and mine for the other. There was no previous rubbing or cleaning of the skin.

On the negative side the experiment shows that neither the needle, spreader, nor method of spreading could be said to influence the count. On the positive side it brings out a very important point—viz., that on the only two occasions on which there was a mononuclear increase, a marked increase in each case, it was in *the first drop* from each ear. Now Colonel Groube had always been in the habit of using the first drop from the ear for making his films. Some people use the second. So this might account for the high mononuclear counts associated with his films as compared with theirs; but it could not account for the different results between his and mine shown in Chart I, because I too had used the first drop. Clearly then some additional factor was at work.

Chart III shows an experiment on a healthy man who had never had malaria, to see if a marked mononuclear increase could be obtained in the first drop of blood from the ear in such a case; also to test the influence, if any, of (1) the person pricking; (2) the kind of prick.

Colonel Groube had been in the habit of employing a slow method of piercing the ear, whereas I used a quick stab.

The experiment shows that :—

(1) It *is* possible to obtain a marked mononuclear increase in the first drop of blood from the ear in a normal case.

(2) The kind of prick has no influence, as Colonel Groube produced this increase by either the slow or quick method.

The experiment also brings out another point—viz., that though Colonel Groube produced an increase in the first drop from each ear when using his own needle in the first round, he failed to produce it when using my needle in the second round, and I also failed when using his or my own needle

CHART III.

Person pricking	Lobe pricked	Kind of prick	Needle used	Successive drops	Percentage of large mononuclears
Colonel Groube	Right	Slow	Colonel Groube's	First	**30·7**
				Second	5·7
				Third	5·2
	Left	Quick	Colonel Groube's	First	**46·2**
				Second	5·5
				Third	6·0
	Right	Slow	H. C. L.'s	First	7·5
				Second	5·7
				Third	7·0
	Left	Quick	H. C. L.'s	First	8·5
				Second	9·0
				Third	7·7
H. C. L.	Right	Slow	Colonel Groube's	First	8·0
				Second	6·0
				Third	6·2
	Left	Quick	Colonel Groube's	First	5·2
				Second	7·0
				Third	5·0
	Right	Slow	H. C. L.'s	First	6·5
				Second	6·0
				Third	6·5
	Left	Quick	H. C. L.'s	First	7·2
				Second	5·0
				Third	5·2

in the third and fourth rounds respectively. This will be referred to later. Suffice it to say here that in a further series of experiments on normal controls I found that, irrespective of the needle used, when I pricked a man's ear without it having been previously pricked by Colonel Groube, I could produce a mononuclear increase in the first drop as often as he could. Exceptionally, when the first drop showed a marked increase, the second drop also showed an increase, but much less than the first. Thus in a case in which the first drop taken was a very small one, the mononuclear counts were—first drop, 28 per cent.; second drop, 15 per cent.; third drop, 8 per cent. The probable explanation in this case was that, the first drop being a very small one, part of what would otherwise have formed a first drop of ordinary size, remained to take part in the second. The mononuclear count in the latter was thereby raised. On the other hand, if a very large first drop had been taken its mononuclear count would probably have been lowered by partial dilution with the second. For comparative counts in all subsequent experiments the first and third, rather than the first and second drops, have therefore been taken, and the first drops have never been allowed to become large.

Chart IV shows an experiment to compare the counts in the first and third drops from a single puncture from each of the four places usually chosen for obtaining blood drops—viz.: (1) Lobe of ear, (2) border of ear, (3) base of finger nail, (4) pulp of finger. Blood was also taken from the vein.

The first six cases were normal men who had never had malaria.

Nos. VII and VIII were malarial cases with parasites in the blood at the time. No. IX was a questionable case. The round of punctures was done by myself on each man, only a minute or two elapsing between each part punctured.

CHART IV.

Case	Percentage of large mononuclear leucocytes								
	Lobe of right ear		Border of right ear		Base of nail		Pulp of finger		Vein
	Drop I	Drop III	Drop I	Drop III	Drop I	Drop III	Drop I	Drop III	
I.—Normal... ...	**24**	5	**20**	6·5	7	7	5·2	6	5·5
II.—Normal ...	**35**	7	**41**	8·5	6·5	8	6	5·5	7
III.—Normal ...	8	8	**27**	6·5	7	7·2	5·5	8·2	6·5
IV.—Normal ...	**22**	11	10	10	9·2	12	11	9·5	9·5
V.—Normal ...	9·5	7	6·5	7·5	6	6	8	5·2	6
VI.—Normal ...	10	9·2	**16**	8·5	12	10	9·5	11	8
VII.—Malarial, *Plasmodium vivax*, heavy infection, late amœboid forms and schizonts	**28**	**20**	**37**	**21**	**20**	**20**	**22**	**21**	**19**
VIII.—Malarial, *Plasmodium vivax*, scanty infection; very few early amœboid forms	**32**	9	**31**	8·5	9·5	8	7·5	8·5	8·5
IX.—? Malarial; no parasites found; history of relapse ending three days before taking films	**19**	**17**	**33**	**15**	**17**	**19**	**16**	**17**	—

Taking the normal cases first, the important points brought out are :—

In the Case of the Ear.—(1) Whether the blood is taken from the lobe or border, if the large mononuclears are raised at all they are up in the first drop but not in the third.

(2) The degree of mononuclear increase varies not only in the first drop taken from different people, but may also vary from different parts (lobe or border) of the same ear. Sometimes the mononuclear count is normal in the lobe and well up in the border, and vice versa. *See* Cases III, IV, and VI.

(3) There may be no mononuclear increase in the first drops from either lobe or border of the ear (*see* Case V). This case also exemplifies another point—viz., that the same man may show an increase at one time and not at another. Case I and Case V happen to be the same man, on whom a complete round of punctures was performed on different days.

In the Case of the Finger.—(1) Whether the blood is taken from the base of the nail or pulp of the finger, the large mononuclears are not raised in either the first or third drops.

(2) The counts from the first and third drops correspond not only with each other, but also with counts from the third drops taken from the ear.

In the Case of the Vein.—(1) The count corresponds with any drops from the finger and with the third drops from the ear.

Bearing on these results, it may be mentioned here as a point of interest that Sir Ronald Ross had been in the habit of pricking the finger in the case of his private patients, whereas for pensioners at the clinic he always used the ear. In each case he took the first drop. It became apparent in the light of these experiments why it was that the large mononuclear counts in the two sets of cases were so different.

Now compare these results from the six normal cases with the two definite malarial cases (VII and VIII) and the questionable case (IX). Case VII was heavily infected at the time with *Plasmodium vivax*. Late amœboid forms and schizonts were present. The third drops from the lobe and border of the ear, the first and third drops from the finger, and the venous blood all showed a large mononuclear count of approximately 20 per cent.

This represents a *true* picture.

There is a *true* increase of these cells in the circulating blood. In the case, however, of the first drops from the lobe and border of the ear there has been superadded to this true increase a *false* one, the counts being raised to 28 per cent. and 37 per cent. respectively.

Case VIII was very scantily infected at the time, only an occasional early amœboid form being found. The third drops from the lobe and border of the ear, the first and third drops from the finger, and the venous blood all showed a normal mononuclear count of approximately 9 per cent., which represents the *true* picture. The *false* picture is shown in the first drops from the lobe and border of the ear in which the counts have been raised to 32 per cent. and 31 per cent. respectively.

Case IX resembles Case VII in that it shows a *true* mononuclear increase all the way through, with a superadded *false* increase in the first drop from the border of the ear.

No parasites could be found, but the patient gave a history of having contracted malaria in 1918 with subsequent relapses. His spleen was palpable, and he was slightly anæmic. He stated he had had a relapse, which had confined him to bed, and which had ended three days previous to attending the clinic, when the blood films were taken.

This is the sort of case in which there is a history of a very recent relapse, when a reliable count *may* help in the diagnosis, a high mononuclear count being evidence in support of malaria, a low one not helping one way or the other.

The Number of Large Mononuclears per cubic millimetre.—A false picture, when it occurs, is not confined to the percentage leucocyte count. When there is a percentage increase in the large mononuclears in the first drop from the ear, but not in the third, there is also in the former an *absolute* increase of these cells. The normal number of large mononuclears per cubic millimetre is 450-750. They may be increased to as many as 6,000 per cubic millimetre in the first drop.

The Total Leucocyte Count.—This *may* be considerably raised in the first drop of blood taken from the *ear*. Occasionally it has reached as high as 20,000 per cubic millimetre, when the total leucocytes in the third drop were less than 10,000. The importance of this fact cannot be exaggerated. It will form the subject of a later paper.

Theories as to the Causation of the Phenomena observed.—These facts being established their explanation became a matter for investigation. The questions which presented themselves were:—

(1) What could be the cause of the sudden increase of these large mononuclears, and where could they come from ?

(2) Why, when an increase occurs, does it do so in the first drop of normal size from the ear, and not in the subsequent ones ?

(3) Why should it vary so much in degree, and sometimes be absent even in the first drop ?

(4) Why should the finger behave differently to the ear ?

The possibility of the phenomena being in the nature of a reaction was first considered. It was just conceivable that the large mononuclears, called by Metchnikoff "macrophages" because their chief function is to take up certain foreign bodies, might be attracted to the point of stimulation. But the lightning rapidity of the reaction, the fact that it sometimes occurred and sometimes failed when the same ear was pricked, and that it did not occur at all when the finger was pricked, rendered this theory untenable.

Everything therefore pointed to the phenomenon being due to the tapping of a concentrated source of supply of these cells. The only two sources of supply could be:—

(1) The lymph spaces and capillaries.

(2) The blood stream.

The Lymph as a Source of Supply.—Gulland and Goodall[1] state that it is well known that these large mononuclear cells are to be found in abundance in the main lymphatic ducts. Might they not also therefore be present in considerable numbers in the smaller lymph ramifications, and might not the loose tissues of the ear be richer in lymph spaces than the dense tissues of the finger ?

According to this theory, whether a large or small number of large mononuclears appeared in the first drop of blood would depend on whether a large or small source of supply was tapped. It was thought that these cells might be poured into the line of puncture from the ruptured lymph spaces and lymph capillaries, and be carried along with the first drop of blood, the subsequent drops being free from them. If this was so, then squeezing the ear to express the drops should increase their number. But this was not found to be the case. Some of the highest counts occurred in the first drops which exuded without any pressure being applied, and often when hard squeezing was resorted to the counts were not up at all. It was never found possible by squeezing to increase their number in the later drops. Moreover in other parts of the body where the tissues are more loose than in the finger the first drops of blood failed to show an increase in these cells over the subsequent drops.

When it is possible to get a sample of tissue fluid this is found to be rich in lymphocytes, but not in large mononuclears. The fluid is most easily obtained by making a shallow puncture on the tip of the nose and squeezing hard. It is generally blood stained but may be obtained as a clear yellow liquid almost free from blood. It is less easily obtained by slightly puncturing the base of the nail with the terminal phalanx extended, and then pressing hard round the point of puncture. Admixture of this fluid with the blood raises the lymphocyte, but not the large mononuclear count in the blood film.

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[1] Gulland and Goodall, "The Blood."

The Blood as a Source of Supply.—Reference has been made before to the curious fact shown in Chart III that after Colonel Groube had pricked the lobe of each ear once, and obtained a high mononuclear count in the first drop from each puncture, but not in the second and third drops, when in a second round he again punctured the lobes he failed to get this increase, and so did I in the third and fourth rounds.

This "second-round phenomenon" was observed in a further series of experiments, and though the mononuclear counts in the first drops of the second round were sometimes raised, they were always lower than in the first round. It could not be supposed that one puncture had drained the mononuclears away from the region of the second. What had intervened then between these two punctures, apart from the loss of three drops of blood, which might account for the different results?

The ear had been grasped, and more or less pressure employed to express these three drops. Colonel Groube always grasped the lobe firmly and wiped it clean between each drop of blood with dry cotton wool.

Could the explanation lie in the increased blood circulation set up in the lobe of the ear by these manipulations?

Gruner, in speaking of the birth of the large mononuclears, says: "Granted that the majority of these cells come from the pulpar tissues, there are no laws apparent determining how many or which individuals shall be swept from their nesting places at any given time. It must, however, be assumed that their natural habitat is in the capillary recesses where the stream is slow."[1] Now the circulation in the ear is not subjected to muscular contractions. In this respect and in its immobility, the ear, as forming part of the body surface, is unique. The blood stream, therefore, would often be likely to be slow and the large mononuclears to stagnate in the capillaries in this situation, to be washed on only if the circulation happened from some reason or other, local or general, to be increased.

Charts V to VIII show experiments on healthy controls to test this. For brevity's sake only two cases are shown in each chart, and, to show clearly the influences on the large mononuclear count of the various attempts to affect the circulation in the ear, only those cases in which there was a fairly marked increase of mononuclears in the first drop from the initial puncture have been chosen. There were no contrary results in the many others examined.

Chart V represents an experiment to see if the first drop from a second puncture would have its large mononuclear count unaffected when the lobe of the ear is not grasped, but just supported on the finger during the initial puncture, and the first drop of blood allowed to exude without any pressure which might stimulate the local circulation. In other words, can the "second-round phenomenon" be prevented?

The experiment shows that, with this precaution, the count in the first drop from the second puncture is practically unaffected.

Charts VI and VII are experiments to test the effect on the large mononuclear count of changes in the circulation of the ear set up by local influences.

These two experiments show that massage, by increasing the local circulation, lowers a fictitiously high mononuclear count to normal. Similar experiments were carried out in which flicking was employed to increase the local circulation instead of massage. The ear was repeatedly and rapidly flicked from behind with the hand. This was done to meet any objection that massage, in addition to increasing the blood flow, might also disperse any collection of large mononuclears which had gathered in the lymph spaces.

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[1] Gruner, O. C., "The Biology of the Blood Cells."

The results of these experiments were identical with those when massage was used.

CHART V.

Large Mononuclear Counts on the same Lobe.

(Care was taken that no pressure was applied which might increase the circulation when taking the first drops from the first prick.)

Case	Percentage of large mononuclears in right lobe ; ear very gently handled		
	First prick	Second prick	
	Drop I	Drop I	Drop III
I	**28**	**23**	6·5
II	**22**	**19**	7

CHART VI.

Large Mononuclear Counts on the same Lobe pricked before and after Massage.

Case	Percentage of large mononuclears in right lobe		
	Pricked before massage	Pricked after massage	
	Drop I	Drop I	Drop III
I	**24**	7·5	7
II	**18**	8	6·5

CHART VII.

Large Mononuclear Counts on different Lobes. Right Lobe not massaged before pricking. Left Lobe massaged before pricking.

Case	Percentage of large mononuclears			
	Right lobe not massaged before pricking		Left lobe massaged before pricking	
	Drop I	Drop III	Drop I	Drop III
I	**19**	4·5	5·5	5
II	**28**	7·5	8	7

Chart VIII is an experiment to test the influence on the large mononuclear count in the ear of a sudden increase in the general circulation due to exercise. The exercise employed was holding the hands above the head, and then bending down to touch the toes eight times.

CHART VIII.

Large Mononuclear Counts on the same Lobe, pricked before and after taking Exercise.

(Care was taken that no pressure was applied which might increase the circulation when taking the first drop before exercise.)

Case	Percentage of large mononuclears in right lobe		
	Pricked before exercise	Pricked after exercise	
	Drop I	Drop I	Drop III
I	**33**	9·2	6
II	**20**	8	7

The experiment shows that a fictitiously high mononuclear count in the ear is lowered to normal by this exercise. Similar experiments were carried out using different lobes, the right being pricked before and the left after exercise. The results were the same as when the one lobe was used.

Charts IX and X are experiments to test the effect on the large mononuclear count in the ear of heat and cold respectively.

CHART IX.

Large Mononuclear Counts on the same Lobe to test the effect of Heat.

(Care was taken that no pressure was applied which might increase the circulation when taking the first drop before the hot application.)

Case	Percentage of large mononuclears in right lobe	
	Pricked before applying heat	Pricked after applying heat for ten minutes
	Drop I	Drop I
I	**18**	7
II	**26**	5·5

Heat was applied for ten minutes by means of a rubber hot water bottle. The experiment shows that heat, by increasing the local circulation, disperses a large mononuclear concentration.

CHART X.

Large Mononuclear Counts on the same Lobe to test the effect of Cold.

(Care was taken that no pressure was applied which might increase the circulation when taking the first drop before the cold application.)

Case	Percentage of large mononuclears in right lobe			
	Pricked before applying ice	Pricked after applying ice for ten minutes	Pricked after flicking ear to increase circulation	Pricked after again applying ice for ten minutes
	Drop I	Drop I	Drop I	Drop I
I	**41**	**42**	8	7·7
II	**23**	**20**	6·5	7

Cold was applied for ten minutes by means of a lump of ice enclosed in a towel. The experiment shows that the application of cold for this length of time does not lower or raise the mononuclear count. It is quite possible, though, that a prolonged exposure of the ears to cold, as in an east wind, might, by slowing the local circulation, cause the mononuclears to stagnate in the ear capillaries, and so raise the count. These would then be washed on if a brisk reaction set in, such as, for example, on entering a warm room, and the count would then be lowered. This reaction effect after applying ice, and then waiting for ten minutes, was proved by experiment.

Similar experiments were carried out, using different lobes, the right being pricked before the application of heat or cold as the case might be, and the left after the application.

The Effect of applying Ether to the Ear before Puncture.—It is sometimes advised that ether should not be used for cleaning the ear for fear of causing leucocyte attraction. Experiments on similar lines to the above showed that when applied without rubbing, it had no effect on the differential leucocyte count, and when the skin was well rubbed with it the circulation was increased, and a reliable sample of blood thereby obtained.

These experiments prove then that the circulatory theory is the correct one. If the circulation is slow then the large mononuclears tend to stagnate and cling to the capillary walls. The first drop of blood which exudes after puncture carries these cells with it. They come from the capillaries which are tapped and which are then refilled by blood from the arterioles. Hence the second drop is generally normal, but the third or subsequent drop is the most reliable. On the other hand if the circulation in the ear is rendered brisk, either intentionally or unintentionally, by rubbing, massage, exercise, or heat, then these large mononuclears are washed into the general circulation, and the first drop of blood is then reliable. It is probable that the circulation in the ears of some people is normally more brisk than in others.

In the case of the finger the circulation is kept going by muscular movements, hence the first drop of blood like the subsequent drops is reliable.

Now it is occasionally mentioned in text-books, generally in connexion with total red and white counts, that the first drop of blood, whether from the ear or finger, should be discarded. As a rule no reason is given for this advice, or if one is given, it is "for fear of possible contamination from the skin." This is not worth consideration. It is only natural, therefore, that many have paid no attention to it, and have used the first drop. Now, however, that it has been shown how great an error *may* be introduced in the case of blood taken from the ear but not from the finger, the importance of discarding the first two drops of blood from the former situation cannot be exaggerated. It is because this has not hitherto been recognized, and because blood has sometimes been taken from the ear and sometimes from the finger that such discordant results have been obtained, and opinions as to the value of the large mononuclear leucocyte count as an aid to the diagnosis of malaria are so much at variance.

It must also be answerable for many cases wrongly diagnosed as malaria, and for many in which the disease has really died out, but which, owing to an erroneous count, are still being treated as cases of latent malaria.

CONCLUSIONS.

(1) A gross error *may* be introduced in the differential leucocyte count if the first drop of blood is used from the ear. Much less frequently this applies to the second drop.

(2) The error is due to a concentration of the large mononuclear leucocytes in the ear capillaries. When this concentration is tapped by puncture, the excess appears in the first drop of blood, less frequently in the second, but not in the third.

(3) The concentration itself is due to the slowing down of the blood stream in this situation. The ear, owing to its immobility, the absence of muscular contraction, and probably to its exposed position to cold, is peculiarly liable to have its circulation retarded.

(4) When on the other hand its circulation is rendered brisk, either intentionally or unintentionally by rubbing, massage, exercise, or heat, this concentration of large mononuclears does not take place, and the first and second drops are then reliable samples of the blood in the general circulation.

(5) These local variations in the circulation explain the different mononuclear counts obtained at different times from the same ear, when these drops are used.

(6) The total leucocyte count *may* also be raised in the first, and to a less extent in the second drop, when it is normal in the third.

(7) When taking blood from the ear for either a differential or total leucocyte count, it is therefore advised that the ear should be rubbed or massaged before puncture, and no drop earlier than the third used.

(8) These remarks do not apply to blood taken from the finger which is always reliable whether the finger is rubbed or not, and whichever drop is taken, provided excessive squeezing is avoided as this expresses tissue fluid. Admixture of this fluid with blood raises the lymphocyte, but not the large mononuclear count.

(9) Errors in the large mononuclear count due to taking the first or second drop from the ear have led to many cases being diagnosed as malaria in those who are not suffering from this disease.

I wish to express my thanks to Sir Ronald Ross, Dr. Broughton-Alcock, and Colonel G. P. T. Groube, for the interest they have taken in the work, and to my laboratory assistant, Mr. T. Harrison, for his valuable practical help.

DISCUSSION.

Sir RONALD ROSS remarked that in drawing specimens of blood his custom had been to prick the finger at the back of the nail, until he started at the clinic, and he then commenced to prick the ear. He had not troubled to wipe off the first drop. He thought the observations of Dr. Lucey might be used clinically; they might give valuable evidence of the rapidity of the circulation in certain cases, and personal variation in this respect could be studied by means of it. People with a large mononuclear count might have a slower circulation than others. With regard to the test, he had not done original work on this subject for the last twenty years, but he did not consider it of much value. The subject of large mononuclears was another question. Dr. David Thomson made, with himself, many years ago, careful examinations on total mononuclear counts, and Dr. Thomson's work was so careful that he (Sir Ronald) would accept his statements that there was a total increase of mononuclears in sleeping sickness and in malaria; he believed those were the only parasitic diseases Dr. David Thomson dealt with, not bacillary infections in which there was a comparative increase in polymorphonuclears. The total number of cases of malaria in the Army in Salonica alone was about 150,000, and a comparison of that number with the 82,000 mentioned that night by Dr. Price, showed that a natural decrease in the number infected was going on, because he thought it likely that every pensioner who felt he had any excuse for thinking he had got malaria would have applied for a sum of money in respect of it.

Professor WARRINGTON YORKE (Liverpool) said that in his city three or four years ago they had investigated this question, namely, that of the differential leucocyte count, at considerable length, when nearly a million leucocytes were counted. To a certain extent, he could confirm what Dr. Lucey had said now as to the increase of mononuclears in the first drop of blood drawn from the ear. But he did not think that was always so. He and his co-workers found, however, there was a more fundamental difficulty than that, namely, was it possible to perform, with any degree of constancy, a differential leucocyte count on any person, normal or otherwise? In other words, if two persons made a differential count of the same individual, or if one person made two counts from the same individual, would the results agree with each other, within reasonable limits? It was a very important matter. The differences in that respect they found were very marked and for simplicity's sake they soon gave up attempts at classing leucocytes into their sub-groups, and directed their attention, rather, to considering mononuclears, including leucocytes, as a whole, and polymorphonuclears. An epitome of this work was published some time ago in the "Annals of Tropical Medicine and Parasitology," under the title "Have Differential Leucocyte Counts any Value?" They concluded that, as done at present, differential leucocyte counts had no value; they found that if two people counted the same film, or even if one person counted different parts of the same film, remarkably different results were obtained, the mononuclear percentage varying as much as 20 to 30 per cent. The distribution of the leucocytes over a film showed a wide variation. Usually the mononuclears were most numerous in the centre, and the polymorphonuclears near the extreme end or edge. The edge count gave the figure which approximated most closely to that of the whole film. But if two persons even confined their attention to the edges, their results often differed by as much as 12 per cent. Before hoping to proceed further, such differences had to be explained. It was evident that the distribution of leucocytes in a film, or even in definite areas of the film (edge area), was very irregular, and consequently whilst one person might strike a bit which was rich in mononuclears, another might encounter an area poor in them. Differential leucocyte counts, therefore, apart from eosinophilia, they regarded as useless at the present stage of the research. There was only one way of diagnosing malaria, and that was, by finding the parasite. The term "latent malaria" had been used on the present occasion, and he thought it should be clearly defined, and that opinion should be crystallized in regard to it. Dr. Alcock mentioned an enlarged spleen as a clinical sign of latent malaria, but was an enlarged spleen in a man who had had malaria a sign that he still had the disease in a latent form? It might mean that such a man had had malaria, but he understood "latent malaria" to mean that he still had malaria parasites in his blood or body. Certainly the great majority of simple tertian cases would relapse in a month if left without quinine. With the pensioners the proper course was to stop their quinine, paying no attention for a period to their reports of ague and rigors, and then to examine the blood. Doubtless many pensioners were suffering from the after effects of malaria, but he did not know that quinine would benefit them if their infection had already died out, and, consequently, there appeared to him no justification for continuing to pour quinine into patients in whom a definite microscopical diagnosis that they were still infected was not made.

Professor SIMPSON (speaking as President of the Royal Society of Tropical Medicine) in response to the President's invitation, said that he had no intention of speaking when he came, but he would like to take the opportunity of congratulating Sir Leonard on his attainment to the presidency of this Section, which men engaged in tropical disease work would take to be a recognition of the splendid work Sir

Leonard had done in this field, of which he would specially mention his researches into cholera, leprosy and tuberculosis. As he had not had experience of recent refined microscopical examinations of the blood he did not feel in a position to criticize the two papers which had been read, but, having visited the laboratories in which the authors worked, he was able to pay a tribute to the excellence of the efforts they were putting forward; he had been much impressed by all he saw there. The clinical work was thoroughly done, it was supplemented by careful laboratory work, and the results were recorded in such a way that he was not surprised to see the outcome presented in the elaborate and valuable tables which had been distributed. The wealth of material so well being used would inevitably result in much good to the patients. Probably other centres in the country were doing similar work, but in any case this work was a fine example of what could be achieved.

Dr. ARTHUR POWELL was greatly interested in Dr. Lucey's facts, whatever might be their explanation. He could not agree with Professor Yorke to "scrap" the leucocyte count as a useless diagnostic factor. Conditions in the Ministry of Pensions were very different to those found in the tropics. In India when the parasites could not be found an every-day difficulty was to distinguish malaria from tuberculosis, the enteric group, or seven-day fever. It was a remarkable fact that in perhaps the majority of Indian cases of tuberculosis, the first symptom was fever, long before cough set in, and before any physical signs could be found in the lungs. In such cases he and many others had found the leucocyte count very helpful. His observations were on in-patients, many soldiers and policemen, whose after-history was followed up, and who were compelled to remain in hospital while ill. In the majority of cases among pensioners at the Chelsea clinic the sole evidence that a malarial infection persisted was the interested statement of the patient. In scarcely a quarter of them was there splenic enlargement or any physical evidence of malaria. In less than 800 of Dr. Alcock's 28,000 cases was the diagnosis confirmed by the finding of parasites. In Dr. Powell's experience the large mononuclears were not increased on first infection, but a few days after the onset of fever, when diagnosis might present difficulty, there was generally a decided increase. They were indebted to Dr. Alcock for showing the condition one to three years after infection in cases who had undergone prolonged quinine treatment. He agreed with Professor Yorke as to the importance of the personal equation in making leucocyte counts. If films were sent to separate observers the results would differ, but it was fair to compare with one another the counts of one skilled observer with his own fixed standard.

Dr. GORDON THOMSON said a very important factor in these examinations was the time or period at which the examination of the blood film in malaria was made. Billet pointed out, in 1908, that during paroxysms of the fever there was leucopænia. Professor Andrewes had stated that during a paroxysm of any fever, such as pneumonia, leucopænia occurred. Billet said that the curve of leucocytes was in inverse proportion to the temperature—i.e., when in malaria the temperature was high, the total leucocyte count was low, and vice versa; also that in the interval between the paroxysms the leucocyte count was high. David Thomson, in Liverpool, confirmed Billet's work in 1911. In the two papers no mention was made as to when the films were examined. David Thomson pointed out that the variation in the leucocytes continued after the fever had disappeared, that rises and falls persisted even when the patient was supposed to be cured, and that these variations corresponded with the periods of the relapses the patient had suffered. In order to get an exact picture of what was taking place in the blood, it was necessary, in the latent cases, to take a blood film and examine it every four or every six hours for three days or so, in order to arrive at a proper percentage of the total mononuclear count; he did not know whether that had been done by observers at the Ministry of Pensions. The authors had made valuable observations in a large number of cases; Dr. Lucey's observations on the blood drawn from the ear were particularly important; his (Dr. Thomson's) own practice for years had been to take the blood from the pulp of the finger, therefore such serious mistakes had not occurred.

Dr. H. J. B. FRY said he had carried out at the laboratory 1,083 differential counts during 1920. Those observations were not of any appreciable scientific value, because the laboratory had only just been started, and the work was carried out under considerable technical disadvantages, and in addition the counts were done on all slides received, without reference to the clinician, to the source of the blood, or to the technique of taking it. In these 1,083 cases he had obtained only twenty-seven positive films containing malaria parasites, these being all *Plasmodium vivax*. A mononuclear count above 10 per cent. was found in ten cases, and below 10 per cent. in seventeen. The character of the mononuclear count bore no apparent relation to the stage of the parasite in the blood, nor to the period elapsing between the attack and the taking of the film. Nor could he find any certain evidence as to increase of the mononuclear count in relation to enlargement of spleen, enlargement of liver, anæmia, or cardiac insufficiency. He therefore came to the conclusion, on these examinations, that the mononuclear count was of no special significance for the diagnosis of malaria in pensioners in this country, when parasites were not found in the blood films.

Dr. BASIL PRICE pointed out that the total assessments on account of malaria in 1920 were 80,000, but the first claims made during 1920 for malaria as a pensionable disability was 52,480. He could not speak from personal work as regards the mononuclear count question, but recently he had had the opportunity of comparing the opinions of sixty medical men throughout the Kingdom who had carried out special work of their own, and had long experience in connexion with tropical subjects; it revealed an extraordinary diversity of views as to the value of the count of mononuclears. To refer to all of them would take too long, but for every statement one man made, another seemed to hold a different opinion. That was very important as revealing fallacies which must still underlie technique and observation. From the point of view of the State and its expenditure, this question was a very important one. because the generally quoted statement that a relative increase in mononuclears indicated the presence of latent malaria had largely influenced Medical Boards in assessing the degree of disability of men claiming pensions for malaria contracted on service; this test was regarded as of great importance in the absence of finding the actual parasites. If the significance of a relative increased mononuclear count should be found to be fallacious as regards the indication of malarial infection, particularly latent malaria, an important revision of opinions must ensue.

Professor LEONARD S. DUDGEON stated that in the Winter of 1916-17 the Director of Medical Services to the Balkan Forces attached three officers to him for special duty in the Struma Valley, to investigate the proportion of "malarial carriers" in the fighting forces there. Cases were taken among those who had been admitted to hospital or who had reported sick from any cause. The majority of these men were taking quinine either in tabloid form 5 gr. daily, or 10 gr. three times weekly. The examinations were made during the winter months at a period when re-infection would be at its lowest range in this highly infected area. Care was taken to prevent overlapping and thus to avoid recording the same case on more than one occasion. Out of this grand total (2,836), 724 had parasites present in their blood at the time of the examination, while 312 cases had 15 per cent. or over of large hyalines, and 111 showed pigmented leucocytes, the vast majority of which would be large hyalines. No parasites were found in these cases. It would thus be seen that a very large proportion of these cases showed a very great increase of large hyaline cells. In 1,053 cases of probable malaria in the same area, 1,010 gave a definite history of malaria, 471 had had two or more relapses, 219 had parasites present in the blood at the time of the examination, while 399 showed an increase of 15 per cent. or more of large hyalines although no parasites were found. In the records of the pathological department of St. Thomas's Hospital for 1919-20 there was no case apart from malaria in which the large hyalines amounted to 15 per cent., and only 1 per cent. of cases with a large hyaline count of 10 per cent. These figures were in striking contrast to those given for malaria in the winter season in the Balkans. He personally took samples of blood generally from the thumb and by no means infrequently from a vein. He remembered as a medical student that the teaching in the physiological department was to avoid the first drop of blood from the ear owing to an apparent increase of mononuclear cells, but in practice he had never observed a definite increase of large hyaline cells in the blood from the ear as opposed to blood obtained from other parts of the body.

Dr. CASTELLANI said that with regard to the differential leucocyte count in malaria, his experience he could briefly indicate as follows (he referred to his work in Ceylon): In a certain number of cases, mononucleosis was absent; in about 50 to 60 per cent. of the cases in Ceylon it was present, but in a degree which varied greatly. He therefore considered the absence of mononucleosis to be of no importance whatever in the process of excluding malaria. The presence of mononucleosis he was inclined to regard as one of the minor complementary signs which occasionally helped in the diagnosis of latent malarial infection.

Dr. ERNEST BLACK remarked that Professor Yorke said that nothing was proof of a case being one of malaria except the presence of the parasite; but he seemed to have overlooked the fact that when the parasite was not in the peripheral blood or was too scanty to be detected, the presence of the characteristic pigmented leucocytes established the diagnosis of malaria. Another speaker described the pigment as melanin. The pigment in the leucocytes was derived from hæmoglobin, and was hæmozoin, which was not melanin.

Lieutenant-Colonel WILKINSON asked the authors of the papers if they had attempted to find any useful sign of latent malaria. other than finding the parasite or its pigment, as their work would seem to offer exceptional facilities for such an investigation.

Dr. CHRISTOPHERSON said he had not heard mentioned in this discussion the effect on the large mononuclear count of various drugs taken by the patient. Some drugs seemed to him to influence that count, certainly some drugs increased it, and perhaps some had the effect of diminishing it. That might account for some of the wide variations in the results. He referred to such drugs as tartar emetic.

The PRESIDENT said the subject had interested him greatly for very many years, and in looking back, he wondered whether the results achieved had been commensurate with the expenditure of time on it. The discussion had not thrown very much light on what those interested in tropical diseases most wanted to know, namely, how long the large mononuclear increase continued in a patient after actual fever had subsided. He believed the general idea was, that if a patient had not had an attack for a week, there would be a reduction of this increase. But during recent manifestations of the disease there was no doubt about the value of an increase in the large mononuclears. His experience was that particularly in the benign tertian form—the large proportion in the Army were of that form—this count was most useful. When investigating 200 cases in Calcutta years ago, he pointed out that in benign tertian cases with longer intervals of pyrexia one found a large mononuclear increase more frequently than in the malignant tertians, as in the intervals between attacks. when the temperature had subsided, a large mononuclear increase was mostly found. When examining a slide of blood for malaria, he looked first at the edge of the slide, and if he found there a considerable number of large mononuclears, he examined further for the malaria parasite. If, however, the patient, before coming into hospital, had been having large doses of quinine and the parasite had disappeared from view, and the attack had been recent, an increase in large mononuclears was of great diagnostic value.

Dr. BROUGHTON-ALCOCK (in reply) quite agreed with the President that he (the speaker) had not been able to carry the diagnosis of latent malaria much further, but he had asked the opinion of many in regard to diagnosis of malarial pensioners in this country. In the tropics among malarial cases there was marked mononucleosis in the apyrexial period; but when coming back to England, in the case of pensioners who had malaria one, two, three years ago, one was faced with a different proposition, and he would have been very glad if this meeting had afforded him confirmation or refutation of his contention in regard to the large mononuclear count.

He agreed with Professor Warrington Yorke's remarks as to the personal equation and the differing results recorded on that account. When one speaker referred to the large mononuclear cell, and another to the large hyaline cell or macrophage, &c., did both refer to the same cell? Was not the idea of giving one name to these large mononuclear cells worth consideration? If it could be agreed that all were endothelial cells, why not call them endothelial leucocytes? Then it would be known what each worker meant and they would be classified under one name, and—another point—any confusion with the large lymphocytes would be avoided.

With regard to his use of the term "latent malaria," he had called it that because he presumed these people had had malaria and might have the parasite in the body at the time the blood film was sent for examination, and because the men had been examined by three medical men on a Tropical Board, and were sent to the tropical diseases clinic for malarial treatment. In latent malaria the parasite might be found in the blood. Craig found in a series of examinations 21 per cent. out of 1,267 positive findings were in latent cases. And with regard to an enlarged spleen, that was generally accepted as a sign of latent as of acute malaria; it was difficult for him to say what was the most important clinical sign of the latent disease, as he was not a clinician, but from the opinion of experienced clinicians he had been associated with, and judging from what he had himself seen, he thought it an important clinical sign. Professor Yorke's idea of stopping the quinine and seeing if the parasite could be found in the blood was, he feared, one which would be difficult of application.

He had valued the visit of Professor Simpson to the Central Laboratory because it gave an opportunity to ask him what he thought of the work, and whether he could suggest improvements. He hoped members of the Royal Society of Tropical Medicine would come to see the Central Laboratory and discuss and criticize its methods and findings.

Dr. Powell took up a strong attitude in support of the diagnostic value of mononucleosis, but he feared that gentleman had overlooked what he (the author) had tried to bring out in the paper, namely, that his experience in the Mediterranean littoral confirmed Stephens and Christophers' work; we were not dealing with cases in sub-tropical countries, but in England, in which the meteorological and general climatological conditions were very different, and with men who had seen war service in endemic countries and had now returned to their homes. They knew the average malarial case cleared up on quinine after coming to England, but he did not think the same could be said of cases when they remained in endemic areas. He would like to hear from Dr. Powell whether he had proved that malaria in this country gave a constant mononucleosis, such as Dr. Powell found to be the case in India.

Dr. Gordon Thomson had referred to his brother's work and modestly kept back remarks as to his own. He agreed with him that when the temperature was high the mononuclear count was low, and vice versa, and that had been stated in this paper. As to the period when the blood was taken, the answer was, that they took films when they could get them. He had said in the paper that where no time was stated scientific importance could not be attached to the figures (as in Table II).

In answer to Dr. Dudgeon, that investigator took the samples of blood in Salonica, and although it was in the winter, was it not very soon after infection? Also, were they not under Service conditions? Surely there was a very distinct difference between the conditions of those men in an endemic area and of those who had returned some time ago to this country. [Professor DUDGEON: Very few cleared up in the Balkans.]

Professor Castellani supported the importance of mononucleosis in high percentage, but maintained it was a complementary sign. Did this apply to cases at home? [Dr. CASTELLANI: If I find mononucleosis in cases in England, I think it is in favour of malaria, but it is very seldom I do find it here.] That did not help materially so far as pensioners coming for examination were concerned. If such a man had not got mononucleosis, was he to be considered in any other manner? Relative mononucleosis they in the Central Laboratory had found generally persisted until about the sixth or seventh day after the attack and treatment, but after that time was often not detected.

[Dr. CASTELLANI: In the tropics the mononucleosis persists for months.] He would be glad if any member could give him their opinion of the duration of the increase in cases in this country. With regard to Dr. Wilkinson's question as to any other sign indicating malaria, he (the speaker) was in accord with Professor Yorke, that one should look for the parasite, but thought to this should be added intracellular pigment, and if one of those was not found there was no unquestionable laboratory sign leading to a diagnosis.

In answer to Dr. Christopherson, it was agreed that quinine had a leucocytic action, in exaggerating the polymorphonuclear leucopænia, leaving the mononuclears either untouched or increased, and that was marked, according to Rieux, up to ten or twelve hours after taking quinine. [Dr. CHRISTOPHERSON: I was referring to other drugs which these people are often taking, such as "phosferine" and other patent medicines.]

The President had remarked on the fact that no statement was made in the paper as to how long the mononucleosis continued. Sir Leonard's practice of first looking along the edge of the slide, and if there were a large number of mononuclears looking further for the parasite, was sound; he had taught that and the speaker and others had followed the practice. Their time-limit was fifteen minutes as a routine measure, but this was prolonged if a mononucleosis was determined or clinical signs were positive.

Section of Tropical Diseases and Parasitology.

President — Sir Leonard Rogers, C.I.E., M.D., F.R.S., I.M.S.

(Chairman—Sir Robert Hill, K.C.M.G., C.B., C.V.O., R.N.)

The Ankylostomiasis Campaign in Egypt, 1913 to 1915.[1]

By A. F. MacCallan, C.B.E., M.D., F.R.C.S.

I have been looking up the records of the ankylostomiasis work done from 1913 to 1915 and I find that it was the late Mr. Graham, when Director-General of the Department of Public Health, who suggested that ankylostomiasis should be attacked in the country towns and villages by means of travelling hospitals. This project was seconded by Sir David Semple when he became Director-General, and led to the issue of an order by Lord Kitchener in 1913 that I should personally direct a great campaign against this disease. At this time there was already a camp hospital at Qaliûb which was being administered by the Hospital Section of the Department of Public Health with the assistance of an advisory committee consisting of Professor Loos, Dr. Ferguson, Dr. Todd, Dr. Day and Dr. Hastings. It was obvious that hospital treatment, even though reduced to so short a period as five days, as it afterwards was, could not "sweep up" the disease. Therefore, as a preventive measure on taking over the direction of the hospital, I wrote officially to the Director-General requesting to be supplied with the outlines of the possible methods of sewage disposal suitable for country towns and villages in Egypt, in order that experimental latrines might be put up and carried on at Qaliûb town. However the recommendation made that wooden latrine huts with pits, similar to those in use at Tanta Moulid or Fair, was found to be unworkable, and I commenced the erection of brick latrines with a bucket system of sewage disposal. At the same time a branch hospital was opened at Qalama, a neighbouring village to Qaliûb and much smaller, and where it was hoped to eradicate ankylostomiasis by treatment and prophylaxis. The size of the towns and villages is not always realized; Qaliûb according to the 1907 census had 16,000 inhabitants and Qalama 3,000; both must have largely increased since then.

The visit to Egypt of the representative of the International Health Commission in February, 1914, resulted in a grant of LE12,000[2] becoming available for the campaign, and the desires of the International Health Commission, conveyed to me by the Director-General, were to open an extended campaign for the treatment of the disease in a typical province, and to organize in the same province a separate survey of the population in order to arrive at an estimate of the amount of infection. I was at the same time instructed to obtain what information was possible with reference to the incidence of bilharziasis and pellagra.

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[1] At a meeting of the Section, held May 2, 1921.

[2] Of which the Egyptian Government promised LE6,000.

The campaign was transferred to the province of Sharqia by the opening of tent hospitals, each with fifty beds, at Bilbeis, Minia Qamh, Qanayat, Ibrahimia,[1] and Faqus,[1] and preparations were made to open several centres for treatment in houses hired in Zagazig. Also, a notable of the province of Qaliûbia, Ibrahim Pasha Nurad, maintained a hospital at his own expense on his estate.

A survey of the provinces of Sharqia and Assiût was put in hand and completed. All the work of training the Egyptian medical officers was carried out by Dr. Stiven and the late Dr. Kennedy. My part consisted merely in the organization and administration, which I did with the assistance of the late Dr. Lutfi Bey, and with the loyal help of a staff of clerks at my central office in Cairo.

In the surveys, which alone entailed 20,000 microscopical examinations, Dr. Stiven and Dr. Kennedy worked side by side with the Egyptian medical officers and checked their results.

The incidence in Sharqia was shown to be 56 per cent. of the 6,082 male persons (not being hospital patients) examined, or 1 in 65 of the male population. The incidence in Assiût province was found to be 45·7 per cent.

The regional survey of the province was carried out by the collection of specimens of fæces under the immediate superintendence of Dr. Stiven and Dr. Lutfi Bey; the subsequent microscopic examination was made by three medical officers who had been trained in microscopy at ankylostomiasis hospitals by Dr. Kennedy. The whole work was supervised by Dr. Stiven.

Two medical officers simultaneously examined each specimen after centrifugalization under microscopes with mechanical stages; no specimen was considered to be negative until two slides had been examined each for a period of five minutes. The total time, therefore, spent on each negative specimen was not less than ten minutes; when ova were found under the microscope by one doctor the fact was verified by the second doctor looking down the other's microscope.

The province of Assiût is divided into seven police districts, each of which has a capital town. The principal police district, the seat of the Government of the province, was treated somewhat differently to the other police districts. In the capital town, 100 men collected at random by the police, and 200 boys from the kuttabs or vernacular schools, were examined. Here also an examination was made of all the inmates of the prison. In the rest of this police district, specimens were taken from 500 boys in the kuttabs selected from geographically representative villages. In the principal towns of the other police districts fifty men and fifty boys were examined, while from selected villages 500 specimens were taken from boys in kuttabs. In this way 4,445 specimens were examined throughout the whole province, which works out at about 1 per cent. of the male population.

The investigation has been confined to men and boys owing to the difficulty of examining the women in an Oriental country. However, it has been shown that women also are largely affected.

Besides this, considerable information as to the incidence of bilharziasis and pellagra was obtained. Attention was also paid to the aërating property of the blood as estimated by Tallquist's method, that is to say, to the percentage of hæmoglobin present.

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[1] These hospitals were not actually opened though the camps were pitched and all arrangements were made.

As regards treatment, the number of patients treated in Sharqia province mainly by thymol, was nearly 2,000. Of these 353 were re-examined after periods ranging from thirty-one to one hundred and sixty days subsequent to discharge and 73 per cent. were found to be cured as shown by the absence of the ova from the fæces ; this investigation was carried out by Dr. Kennedy personally. This result is good considering that many of the patients must have had larvæ in their tissues on the journey to the small intestine, which would of course be untouched by the drug, which merely acts on the contents of the alimentary canal. The avidity with which treatment was sought at the hospitals in Sharqia was very striking.

Just previous to the outbreak of war a distinguished physician from the London School of Tropical Medicine had been appointed to undertake the scientific part of the work, and a second physician, or pathologist with similar qualifications, was being advertised for. The war, however, prevented these gentlemen taking up their duties. All the ankylostomiasis hospitals were closed early in 1915, and the personnel and equipment used for war hospitals.

It should be understood that the policy of surveying the country to obtain information as to the incidence of ankylostomiasis, and the inception of hospitals for treatment of the disease, to the exclusion of sanitary reforms of the villages, was dictated by the International Health Commission in consultation with the Director-General, no practical method of effecting such reforms having then been discovered.

As regards the direction in which measures can most usefully be directed against ankylostomiasis, I think that there are three main lines along which investigation should be directed as a preliminary to any further campaign. First, a knowledge must be obtained of the habitat of the larvæ which infect man by piercing his skin : as far as I know they have never been found out of the human body in Egypt. There is no evidence up to the present that birkets or borrow-pits containing water have anything to do with the disease, in spite of the efforts of Dr. Stiven and Dr. Kennedy to connect them. Secondly, a workable system of village sanitation must be evolved, which up to the present is entirely unknown. It must be remembered that over large areas the subsoil water rises to within 50 cm. of the surface, rendering disposal of sewage by filters and percolation pits an impossibility during several months of the year. Also, that the invention of a pail system which can be relied upon to remain satisfactory under village control has yet to be made. Thirdly, that the further investigation of the nature and method of action of the ankylostoma toxin should be undertaken, not only with reference to the possibility of a reduction of a specific antibody, but as serving to explain many obscure phenomena in exceptional cases (quoted from a note of the Ankylostoma Committee, dated November 2, 1913). My own feeling is that scientific investigation is required at the present time, and that a crusade is unnecessary. What I do think is required is a central place in every muderia where patients with anæmia can be certain of being examined and treated for ankylostomiasis or bilharziasis on scientific lines. Such facilities for examination and treatment do not exist at the present time, as it would be quite impossible for the medical officers in charge of most of the Government general hospitals to find time for such work. I think that shelters and wards should be built at every provincial general hospital, for the treatment of the disease by medical officers appointed specially for the purpose, all of whom should be under the surveillance of clinical inspectors.

In my experience there is not the slightest difficulty in interesting the villagers in obtaining treatment for the anæmia of ankylostomiasis if the means are provided, nor in persuading them to use latrines if they are kept even moderately clean.

As I have no further responsibility for the investigation of ankylostomiasis, which was an unwelcome, though interesting, interlude in my ophthalmic work, I make no detailed suggestions which might embarrass the authorities as to the lines on which this should proceed. Detailed type-written MS. reports of the work done are filed at the London School of Tropical Medicine by request of Dr. Leiper, and at the Government Medical School Library, Cairo.

Dr. J. B. CHRISTOPHERSON said that the problem of ankylostomiasis in Egypt opened up a large field for investigation and treatment. From his own experience there he emphasized the need for peripatetic hospitals among the villages in order to deal with the three principal plagues of Egypt—namely, ankylostomiasis, bilharziasis, and *Tænia nana* infection—which were diseases of the agricultural rather than of the urban districts. The Egyptian native was very amenable to treatment, and ready to avail himself of it when brought to him by the travelling hospital, but he was unwilling to go out of his way to obtain necessary relief.

"THE MORTALITY AND PROGNOSIS OF CHOLERA TREATED BY THE AUTHOR'S HYPERTONIC SALINE METHOD, BASED ON 2,000 CASES."

By Sir LEONARD ROGERS, C.I.E., M.D., F.R.S. (President).

This paper, read at the meeting held May 2, 1921 (with Discussion), is printed in abstract in the *Lancet*, May 21, 1921, p. 1079.

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SECTION OF UROLOGY.

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Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

PRESIDENT'S ADDRESS:[1]

Modern Progress in Urinary Surgery.

By Sir PETER FREYER, K.C.B., M.D., M.Ch.

As this is the inaugural meeting of the Urological Section of the Royal Society of Medicine I wish to congratulate you on the formation of the Section. As you are aware, when we approached the Council with the proposal to establish a urological branch within the Society our pretensions were of a very modest character, for the proposal was to found a Sub-section of Urology in the Surgical Section. It came as a pleasing surprise to us—mainly, I believe, through the suggestion of the President-elect of the Surgical Section, Mr. Walter Spencer—to have greatness thrust upon us, in the formation of a distinct Section of the Society. Perhaps I may be permitted to say that this recognition marks a distinct and healthy advance in the attitude of the surgical world in England, and particularly in London, which till recently looked askance at the idea of urology being a distinct speciality, though this speciality has long been recognized in, I may say, every other country.

I have next to thank you for the honour you have conferred on me, in electing me your first President—an honour which I appreciate the more, as it was as unexpected as it was unsolicited.

The subject of my address this evening is: "Modern Progress in Urinary Surgery." Perhaps you may consider the word *modern* a misnomer, for I propose carrying you back to a period of some four and a half decades ago, when I had emerged from my student days, briefly describing to you the position of urinary surgery at that time, comparing it with the position it occupies to-day, and rapidly sketching the stages through which the evolution has been accomplished.

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[1] At the Inaugural Meeting of the Section, held May 27, 1920.

And let me premise, in mitigation of the backward state of urinary surgery in those days, that the cystoscope, the urethroscope, the electric forehead lamp, and the X-rays were then unknown, and that soft and semi-solid bougies and catheters had not attained their present comparative perfection.

Retention of Urine.

There is, perhaps, in the whole range of urinary maladies, no other condition attended with such pain, physically and mentally, as acute retention of urine, from whatever cause. When in the seventies of last century relief from this condition was impossible from medicines, hot baths and the catheter, three rival methods of giving relief held the field—puncture of the bladder suprapubically by trocar and cannula, puncture of the bladder through the rectum by a similar instrument, and Cock's operation of tapping the bladder at the apex of the prostate, which was effected by plunging a long and slender scalpel through the perineum into the bladder, with a guiding finger in the rectum. All these methods were frequently followed by grave consequences, which time does not permit me now to enter on. They were all abandoned on the introduction of Dieulafoy's aspirator, which is still in vogue, and affords a safe and practical method of giving temporary relief, by tapping the bladder suprapubically, till the cause of the retention can be adequately dealt with.

Stricture of the Urethra.

At the period referred to there was great surgical activity in connexion with the radical cure of stricture of the urethra. The employment of caustic to destroy the morbid obstruction had been abandoned, though it would not have been quite safe to display ignorance of this method to an old-fashioned examiner! Apart from dilatation of the stricture by instrumentation, two rival methods of dealing with it held the field—internal and external urethrotomy. There was a third method introduced about that period by Mr. Barnard Holt, of the Westminster Hospital, namely, "divulsion," or bursting of the stricture, by forcibly separating the two blades of a split sound introduced through the canal by means of a wedge rapidly advanced between them. This method was short lived owing to the facts: (1) that extensive laceration of the healthy mucous membrane was liable to occur; (2) the shock to the system very frequently caused rigors and suppression of urine; and (3) the rapid recurrence of the stricture. Syme, of Edinburgh, had advocated external urethrotomy in all cases of organic stricture unamenable to dilatation by bougies, on the assumption that recurrence was less likely to occur than after internal urethrotomy. The results did not, however, correspond with his expectation; and, in this connexion, I may say that I have never known a case of external urethrotomy in which the stricture had not a tendency to recur unless kept under control by the periodic introduction of sounds. Internal urethrotomy—the two methods of performing which we owe to two eminent French surgeons, Maisonneuve and Civiale—was stoutly advocated by Sir Henry Thompson, and is the operation of preference at the present time. The operation is now much less liable to be followed by recurrence, as the stricture, instead of being cut to admit a No. 12 sound only of the English scale, is thoroughly cut up to the full capacity of the urethra—viz., to admit a sound size 16—an improvement we owe to the researches of Otis, of America, who, with the aid of his urethrometer demonstrated that the urethra was much more capacious than was previously imagined. Internal urethrotomy is now firmly established as one of the soundest and safest in surgery, and, with due care, is seldom followed by recurrence of the stricture. When external urethrotomy is necessary, as in case of impassable stricture, or one complicated by perineal fistulæ, the method of Wheelhouse, or modifications thereof, is that generally employed.

Urethrectomy, introduced, I believe, by Guyon of Paris, is employed in cases of partial obliteration of the urethra and sometimes for impassable stricture. It is of doubtful value save in cases in which there is complete absence of pus.

VESICAL GROWTHS.

Tumours of the bladder were undiagnosable in those days, and, consequently not attacked surgically. They were treated medically under the general denomination "hæmaturia." In 1880 and in subsequent years Sir Henry Thompson removed a number of bladder growths through a median perineal incision, and with considerable success. The operations were in the first instance of an exploratory character, for, with the diagnostic means at his disposal, he could not be certain till reaching the bladder that the hæmorrhage proceeded from that viscus. He was to a large extent groping in the dark, having to depend on the tactile sense of the finger introduced through the wound to ascertain the presence and nature of the growth; and, no doubt, in many cases the tumour was imperfectly removed. It was not till the introduction of the Nitze-Leiter cystoscope—that inestimable aid to the diagnosis and treatment of urinary diseases in general—and its development towards perfection in subsequent years, that it was possible visually to locate the growth and recognize its size, shape, attachment, and general characteristics before deciding on operation. Suprapubic cystotomy had, as we shall see later on, been revived, and the procedure improved about this period for the removal of large vesical calculi; and this soon became the recognized route for the removal of vesical growths, the conformation of which could not only be felt by the finger, but actually seen during surgical manipulation by the aid of the forehead lamp then introduced. The names of Albarran in France and Fenwick in this country must be prominently mentioned in connexion with this operation, and, more recently, that of my colleague, Thomson Walker, for still more radical removal of the growth The operation is a thoroughly successful and curative one when the growth is benign, single and pedunculated; less so when the benign growth is sessile or multiple, owing to the uncertainty as to the recurrence in the benign, or even malignant form. In the case of malignant growths the operation can only be regarded as ameliorative.

VESICAL CALCULUS.

When I first went to India in 1876, stone in the bladder was invariably treated in that country by lateral lithotomy, with the exception of very large calculi, which had to be relegated to the suprapubic method. The same practice prevailed the world over, except in the hands of a limited number of surgeons who practised lithotrity. We read in the medical history of the early and middle periods of last century of the crowds of students and practitioners that the performance of lithotomy—then regarded as the most brilliant in surgery—by some famous surgeon attracted. I had during my student days in Dublin witnessed only three such operations, and certainly the interest and curiosity alluded to had not then altogether died out. You can imagine, therefore, the thrill of enthusiasm that filled me when, on April 4, 1877, I performed my first lithotomy, which was destined to be the commencement of a series which has now reached 2,119 operations for stone by all methods, and of each one of which I have a careful record. I believe that this is the largest number of stone operations performed by one surgeon in any country or age.

Lithotomy, which consisted in crushing the stone at numerous "sittings" and allowing the débris to escape by the urethra, was invented in 1824 by Civiale of Paris. It was largely advocated and practised by Guyon in France and Sir Henry Thompson in London, and, to a less degree, by others at the early period to which I am alluding. The operation was not popular and scarcely practised in India, for the simple reason that the native of that country would not submit to the numerous "sittings" involved, extending over weeks or months, his temperament demanding for a cure something more immediate and dramatic. The great drawback to the operation was, of course, the fact that the fragments of the stone were left behind in the bladder, which frequently caused cystitis, though, strange to say, the cystitis was attributed to the presence of the lithotrite in the bladder, so that the "sittings" were consequently restricted to a few minutes only. Clover, of London, had in 1865 invented a rubber and glass bottle for the extraction of the débris, but, after employing it for a time, Sir Henry Thompson abandoned it as inefficient, and preferred removing fragments of stone by means of the long and slender lithotrites devised for the purpose by Fergusson.

In 1878, Bigelow, of Harvard, U.S.A., proposed that the stone, no matter how large, and no matter how prolonged the operation might be, should be crushed and evacuated at one sitting, and for this purpose introduced the lithotrites, cannula and aspirator with which, or modifications of them, you are all familiar. The operation, which he termed "litholapaxy" (evacuation of stone) was adversely criticized at first, though subsequently practised by Sir Henry Thompson; and as he was then the leading authority in England in this branch of surgery, his attitude no doubt retarded for some years the general introduction of Bigelow's method. Having ordered the instruments from England I performed my first litholapaxy on July 3, 1882. I published several series of cases of the operation in detail in the *Indian Medical Gazette* in 1882-84; and in the *Lancet* of February 28 and April 7 and 14, 1885, a series of 111 cases of the operation. In this paper I combated the views of Sir Henry Thompson and gave the author of the operation full credit for the successful results obtained. Commenting on this paper at the time the New York *Medical Record* remarks:[1] "Even in India, one surgeon, Freyer, has performed it (litholapaxy) oftener than, may we not say, all the surgeons in the Western, Middle and Southern States," thus indicating the slow progress made by Bigelow's operation in the land of his birth, also that England is not the only place in which a prophet (or surgeon) hath no honour in his own country! I hope you will not consider me presumptuous in saying that the publication of this paper and the success attending these 111 litholapaxies gave an impetus to the operation, particularly in India, where dozens of "batteries" of the instruments were soon ordered, and where tens of thousands of cases of stone have since been successfully dealt with, this operation almost completely replacing lithotomy.

In 1886 Colonel Keegan, of the Indian Medical Service, extended Bigelow's operation to children even of the most tender age, with most successful results, as I can testify from large personal experience. In view of this and other achievements in surgery, particularly his plastic operation for the restoration of the nose, of which great advantage was taken in the war, Keegan must be regarded as a great surgeon and benefactor of humanity; and I am sure you will lament with me the fact that he died recently, unhonoured by any recognition of his work by the Government he served so well.

Litholapaxy is now the operation of choice in the vast majority of these cases, and I may mention that mainly through its adoption in St. Peter's Hospital, the mortality from operations for vesical calculus in that institution has been reduced from 15·3 per cent. in the decade 1874-83 to 3·35 in the last decade and a half.

In 1877, Dr. Garson, then Curator of the Museum of the Royal College of Surgeons, demonstrated in the cadaver that distension of the rectum caused elevation of the bladder, pushing the peritoneum beyond the prevesical space. Petersen, of Kiel, taking advantage of this demonstration, introduced his rectal bag in 1880. Guyon, of Paris, in 1883, and then Sir Henry Thompson in London, advocated and practised the suprapubic operation with the aid of this bag in cases of large and hard calculi. The bag has long since been abandoned, but suprapubic cystotomy, in a more simple and practical form, remains as the best route for the extraction of large calculi, the removal of tumours of the bladder and enucleation of the prostate.

To sum up, then, litholapaxy in experienced hands is the operation of choice in patients of all ages and in both sexes when the stone is of moderate dimensions. Suprapubic lithotomy should be reserved for large and hard calculi that cannot be dealt with in this way, and probably in all cases in the hands of surgeons of limited experience ; also, of course, for cases in which enucleation of the prostate is decided on—the stone and prostate being removed at the same time. Lateral lithotomy has practically died out in this country, though median perineal lithotomy is still retained for impacted calculus of the prostatic urethra growing into the bladder, which cannot be displaced backwards into that viscus, with a view to being dealt with by litholapaxy. When litholapaxy instruments are not available, or the surgeon is inexperienced, lateral lithotomy is still practised in India.

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[1] *Med. Record*, New York, 1884, xxv, p. 556.

RENAL SURGERY.

There is, perhaps, no organ in the body, the diseases of which are more successfully dealt with surgically at the present time than the kidney. But renal surgery was unknown in my early professional days, and apparently undreamt of, for no allusion is made to anything of the kind in the text-books of that period. Surgical diseases of that organ were seldom even accurately diagnosed. They, like tumours of the bladder, were, as a general rule, medically treated, under the denomination, "hæmaturia," the local symptoms being relieved by opiates given internally or by hypodermic injection and by fomentations, or rather poultices. When there was a suspicion of the existence of calculus, recourse was had to ineffectual attempts at its dissipation by means of solvent remedies.

Nephro-lithotomy—first performed by Sir Henry Morris in 1880—may be regarded as the dawn of renal surgery, and to that great surgeon, in large part, we owe the satisfactory position in which surgery of the kidney stands at the present day. Radiography was not invented for many years after and has only recently been brought to comparative perfection ; so that for many years he and we, who have followed largely in his footsteps, laboured under great disadvantages. The X-rays have now been brought to such perfection that the size, shape, number, position and general characteristics of the calculus or calculi in the kidney are clearly defined, so that we can embark on the performance of an operation, knowing practically what to find and where to find it. It is very rarely indeed, that the surgeon would now be justified in exploring for renal calculus unless supported by radiographic evidence of its existence. Nephro-lithotomy is now one of the most successful operations in surgery, as illustrated by the fact that in St. Peter's Hospital in the last five years we have had fifty-eight instances of the operation without a death.

Uretero-lithotomy followed as a consequent, though later, development, and it is difficult to say who was the first to perform this operation. As far as I can ascertain this honour belongs to the late Mr. Betham Robinson, of St. Thomas's Hospital. Be that as it may, with the aid of the X-rays the position and size of a stone lying in any part of the course of the ureter can be clearly defined, and removed extraperitoneally, though when lying in a prolapsed ureter it is necessarily approached through a suprapubic cystotomy.

I find it difficult to ascertain who was the first to perform nephrectomy, but the operation soon followed on Morris's essay with nephrolithotomy, as an established practice for the removal of benign renal growths and malignant growths confined within the renal capsule; injuries of the kidney, gunshot and otherwise; total disorganization of the kidney resulting from calculus; hydronephrosis; pyonephrosis; floating kidney unamenable to less radical treatment; intractable renal fistula; and tuberculous disease confined to one kidney. The operation is now almost invariably performed through the loin, extraperitoneally, as experience has shown this route to be far the safest; but occasionally cases occur in which it is necessary to have recourse to the abdominal or transperitoneal method. I find that in St. Peter's Hospital in the last five years we have performed nephrectomy seventy-one times with six deaths, or 8·5 per cent., which must be regarded as a very satisfactory result, considering that the operation involves the removal of one of twin vital organs of the system.

Ureterectomy followed as a natural development of the operation, the ureter when invaded by tubercle or other disease being partially or completely removed extraperitoneally, either with the kidney or at a subsequent operation.

Nephrorrhaphy, or nephropexy, as it is now generally termed, was devised by Hahn of Berlin in 1881. That surgeon's principle was sound but his technique defective, as he merely stitched the fatty capsule of the kidney to the wound in the loin, which was then packed and allowed to granulate. Many more radical methods of fixing the organ have since been introduced. The main underlying principle in all of them consists in removing a large portion of the fatty capsule on the external aspect of the kidney, then stripping the organ of a considerable portion of its true capsule, and anchoring it to the abdominal wall by sutures introduced into the stripped portions of the capsule, through the cortex, or through both, with a view to plastic adhesion taking place. Some years ago there was a tendency amongst surgeons to employ operative interference in all cases of movable kidney. Then a reaction set in against the operation, owing to the large proportion of cases in which either no improvement took place or a relapse into the previous state occurred. These unfavourable results were probably due to defective methods of operating or employing the operation in unsuitable cases, such as where mobility of the kidney is due to enteroptosis. The operation, is, on the whole, attended by less satisfactory results, but by less danger, than any other in renal surgery.

Enlargement of the Prostate.

The treatment of enlargement of the prostate in those days was merely palliative, the catheter being employed to empty the bladder. The rubber catheter was then unknown, and the gum-elastic catheter was of a primitive character in comparison with the highly polished instruments of various shapes now available. The metal catheter with a large curve and long handle was the weapon in favour, and the use to which it was sometimes put may be gathered from the following extract from a favourite surgical text-book of that period: "When complete retention occurs, it may be necessary to force a catheter through the substance of the prostate"—a practice which I regret has not as yet been entirely abandoned, as specimens of prostate removed by me and in my collection indicate. When, eventually, the catheter failed the bladder was drained permanently either suprapubically or perineally.

In 1885 Bottini, of Pavia, introduced the galvano-cautery for the purpose of removing the prostatic obstruction. The method was practised by many surgeons in this country, in America and on the Continent, particularly in Berlin, and extolled by some; but the practice did not survive the test of experience. I myself have removed the prostate in several instances in which Bottini's operation had failed to effect even an amelioration of the symptoms.

About the same period Mercier, in France, and Gouley, in America, introduced the prostatome for cutting a canal through the obstructing prostate by the perineal route, and I myself witnessed Mr. Norton, of St. Mary's Hospital, perform this operation by means of an instrument devised by himself, resembling a wad-cutter. The operation fell into disfavour as useless.

In 1888 a serious attempt was made in America by Belfield and in this country by McGill to deal with prostatic obstruction, by the removal suprapubically, by scissors and forceps of all kinds, of the intravesical portion of the prostate, on the theory that the so-called "middle lobe" was the main cause of the obstruction to the flow of urine—a view very largely held by the profession at the time, but which was combated by Dittel of Vienna, who maintained that the enlarged lateral lobes were the main cause of the obstruction, and in 1890 removed a wedge-shaped portion of each lateral lobe through an extensive perineal wound, but he found few imitators. McGill's operation enjoyed a temporary though transient notoriety, for apart from the high mortality attending it, in a very large proportion of cases the bladder failed to regain the power of expelling the urine.

In 1892 Dr. William White of Philadelphia proposed double castration with a view to causing atrophy of the enlarged prostate in man, as experiments were said to have done in the normal prostate in the dog. This became the popular operation for a time, displacing McGill's operation. Personally I had no faith in this procedure, and I am glad I never practised it. As in a large proportion of cases the operation was followed by grave mental disturbance it was soon abandoned in favour of double vasectomy—which was supposed to cause the same effect as castration—introduced by the late Mr. Reginald Harrison; and this in turn became the fashionable treatment. Experience proved that neither of these procedures was of any practical value, beyond, perhaps, inducing a temporary amelioration of the symptoms.

Towards the end of last century perineal prostatectomy was practised by Albarran, in France, and Young, in America, and for many years was largely practised in both these countries, but I do not think it ever became very popular in England. I believe it has now been abandoned except by Young and a few imitators in America.

On December 1, 1900, I performed for the first time my operation of total enucleation of the prostate, and in July, 1901, published in the *British Medical Journal*, for the consideration of the profession at large, a lecture delivered by me at the Medical Graduates' College, giving a full description of the operation, with details of four successful cases. I have now completed 1,674 cases of the operation, details of 1,550 of which have been recorded in the numerous papers published in the medical journals. I believe I may say that this operation is now almost universally practised by surgeons.

I have now given you an historical sketch—an imperfect sketch, I recognize—of the stages by which surgical progress has been accomplished in connexion with the diseases of each individual region of the urinary system in the last forty-five years, and thus endeavoured to give you a vivid picture of the wonderful progress that has been achieved in urinary surgery in that period as a whole — to which, as we have seen, British surgeons have contributed no mean part. I venture to say that there is no other branch of surgery in which greater progress has been made, or one which has been attended by greater relief to human suffering. Some of us, indeed, may imagine that urinary surgery has almost reached its zenith. A great countryman of mine once said: "No man can place bounds to the strides of a nation," and surely there can be no limits to the strides of surgery. I have had the good fortune of witnessing and taking a humble part in the great advance described to you. I hope that many of the members of the Section will live to look back on still greater achievements in urinary surgery. I believe that the formation of this Section, by creating a healthy and friendly rivalry in your efforts, and by co-ordinating your work, will have a vast and favourable influence in continuing the progress of recent years.

Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

The Treatment of Subacute Nephritis by Kidney Decapsulation, with an Account of Four Cases of Nephritis in which Decapsulation was Undertaken.[1]

By Sir THOMAS HORDER, M.D., F.R.C.P.

(ABSTRACT.)

[Printed, *in extenso*, in the *Brit. Med. Journ.*, November 13, 1920, p. 727.]

(1) *Historical.*—The decade 1896-1906 saw a good deal of experimental kidney surgery. A few of the cases turned out to be cases of true nephritis. Some successes led surgeons to operate deliberately in nephritis (Harrison, Edebohls, Israel, Pousson). The record of cases was added to by Primrose, Guitéras, Hauchet, Boyd, Tyson, Lyman, Harris, and Clayton-Greene. The early technique consisted of simple puncture, then incision and, later, decapsulation. First one kidney only was dealt with, then both kidneys at different times, then both kidneys together. Many cases operated on, though called cases of "Bright's disease," were evidently not so. Exact knowledge came slowly, partly because of the too rash advocacy of the procedure and partly because of the lack of collaboration between surgeon and physician. The data have not yielded definite indications for the operation.

(2) *The present cases* are presented in two pairs. The first pair were similar in clinical features and were highly successful in their end-results. They give, I believe, material from which more or less exact indications for operation may be obtained. The second pair are recorded largely for comparison: they were only partly successful.

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[1] At a meeting of the Section, held October 28, 1920.

Case I.—J. A., aged 30, a dressmaker, was admitted to St. Bartholomew's Hospital on April 6, 1914. She gave a history of swelling of the legs and thighs, first noticed four months previously, and increasing gradually. She had been short of breath with effort and had vomited on two or three occasions. There was nothing in her past history throwing light upon the origin of the present illness. On examination the patient presented the picture of so-called parenchymatous nephritis. She was anæmic, her face was somewhat puffy, both lower limbs were very œdematous and the œdema involved the loins and lower abdominal parietes. The urine was diminished in amount, averaging 30 oz. in the twenty-four hours, pale, specific gravity 1015, and contained 0·25 per cent. of protein with granular and epithelial casts. The systolic blood-pressure was 120 mm. Hg, the radial artery was not thickened, and the heart was natural. The fundus oculi was also natural. As the result of the customary medical treatment—rest, diet, deprivation of salt, diaphoresis and aperients—the œdema diminished until there was slight pitting in the region of the lumbar spine only, the patient lost 17 lb. in weight, the albumin dropped to 0·1 per cent. and the anæmia improved. She was discharged "relieved" on May 29, 1914. This patient was readmitted on February 27, 1915, stating that she had remained fairly well and at work until early in January, when she noticed swelling of the face, neck and abdomen, and a return of the swelling in the lower limbs. Her urine had become very scanty. She had taken to her bed, but her condition had not improved. On examination she was found to be more anæmic and much more œdematous than at the time of her former admission. There was considerable ascites: the abdomen measured 39 in. in circumference. The heart showed no abnormality except a ringing aortic second sound; the systolic blood-pressure was 116 mm. Hg. The urine was reduced to an average of 20 oz. in the twenty-four hours, specific gravity 1020; protein excretion amounted to 0·4 per cent.; casts were abundant. Vomiting occurred on several occasions. Despite energetic measures on the usual lines, there was no improvement in the general state, and no diuresis established, after a sojourn of six weeks in hospital. At the end of this period, therefore, I asked Sir D'Arcy Power's assistance in the case, and on May 13, 1915, he decapsulated both kidneys. There were a good many perinephric adhesions, more on the left than on the right side. The capsules were more adherent to the kidney substance than is normal, this entailing a certain amount of splitting of these structures during their removal. Both kidneys were probably a little enlarged, slightly mottled, but certainly not pale. The patient made an uninterrupted recovery from the operation. Improvement in the urine excretion, in the œdema, and in the albuminuria began at once. At the end of the second week after the operation there was no œdema, and the urine excretion was normal; the albumin was less than 0·1 per cent. At the end of six weeks, when the patient was discharged (July 3, 1915), her colour was natural, she was quite free from œdema at any time, and the urine showed no trace of protein and no casts. Two months after her discharge she reported herself at hospital saying she was at work and in good health. The urine still contained a trace of albumin. I lost sight of this patient for five years. She then came to see me (January 16, 1920) to ask if I thought she could get married and go to live in India. This gave me an opportunity of examining her. I found no signs of disease, indeed she was in most excellent health, and had been so since she was last seen. Dr. Geoffrey Evans, to whom I sent a morning and an evening specimen of her urine, reported that both of these were quite free from protein and other abnormalities, and were of good specific gravity.

Case II.—J. L., aged 10, was seen in consultation with Dr. Hartigan on October 18, 1914. Six weeks previously there had been slight sore throat and pyrexia, passing off in a few days, to be followed four weeks later by a similar attack. About a week after this second sore throat the child was found to have a puffy face, œdema of both legs, albuminuria, and pyrexia. This was her condition when first seen. She was treated on the customary lines of an acute nephritis, but the symptoms got worse, so that by the end of the second month of the illness the urine was scanty and loaded with protein, casts were abundant, and the dropsy was universal and very marked. The temperature was slightly raised throughout, and showed exacerbations which were accompanied by vomiting, headache, drowsiness, increase in the œdema and anuria. In some of these "crises" the vomiting was very troublesome, making feeding difficult. In addition to the routine remedies, trial was made of an autogenous streptococcus vaccine from cultures derived from the secretion taken from the tonsils. The condition gradually got worse, so that by the end of six months the child's state was most unsatisfactory; the œdema was extreme and involved the peritoneum, both pleural sacs and the lungs. The ascites was relieved on two occasions by paracentesis. At the end of the seventh month I suggested decapsulation of the kidneys, and this was decided upon after further consultation with Sir William Osler and Sir D'Arcy Power. The procedure was undertaken by Sir D'Arcy Power on May 21, 1915, gas and oxygen being administered, with a little ether, by Mr. E. Boyle. The bilateral operation was completed in thirty-five minutes. A great deal of œdema fluid escaped from the lumbar incisions during the operation. The capsules of the kidneys were stripped without difficulty, exposing pale mottled organs of a size large in proportion to the patient's age. The kidney substance was not under any apparent tension. The wounds healed well, and there were no untoward after-symptoms. Diuresis began almost at once, and the œdema rapidly diminished. The after-history in this case is interesting because the condition was complicated by the presence of the infected tonsils. Six months after the operation the patient was found to have a slight degree of œdema of the face and feet at times, and there was slight albuminuria, although the general state was greatly improved. There was at least one "flare-up," with nausea, malaise, and slight increase of both œdema and albumin. This occurred fifteen months after the operation. But the decapsulation had clearly increased the renal adequacy, rendering this in large measure proof against the chronic infection. Dr. Hartigan, however, considered this attack and some subsequent lesser developments of the same sort to be in all probability associated with the septic tonsils, and he decided to have these enucleated. This was done in June, 1918, three years after the decapsulation. The procedure seems to have completed the girl's recovery, for within a month of it the last trace of œdema disappeared and the urine became free from albumin. Since this time she has remained quite well. A letter from her mother, dated October 26, 1920, says: "Joyce is quite well; she has grown a fine girl; does everything, plays hockey, lacrosse, dances; is really wonderful."

Case III.—Captain R. C. L., aged 29, first seen on July 29, 1919, in consultation with Dr. William Roche. His history was as follows: Ten months previously he had an attack which was labelled "influenza" by the medical officer. There was hæmaturia with the illness, frequent and painful micturition, headache. malaise, and nausea. After a week he was allowed up and granted sick leave. He went to Harrogate, but was taken ill again, and saw a doctor who diagnosed his case as nephritis. He was transferred to a military hospital and placed under special treatment in a ward given up to nephritis cases. At this time he suffered from headaches, nausea, pains in the back, and puffiness of the eyes and face in the morning. He was under continuous treatment from the beginning of December, 1918, until April, 1919, when he was sent home on two months' leave. On examination the patient was found to be free from œdema except of the eyes in the early morning. The urine output averaged 30 to 40 oz. daily; it contained 0·2 per cent. of protein, a fair number of red blood cells, a few leucocytes, a few granular casts; specific gravity 1014. There was slight hypertrophy of the left ventricle as judged by some heaving of the impulse, and a booming first sound; the aortic second sound was accentuated; the radial artery was easily felt: the blood-pressure was 175-85 mm. The patient complained of being easily fatigued, of headaches and backache with slight exertion, nausea at times, and suffered from sudden starts as he was getting off to sleep. The fundus oculi was normal. In view of the prolonged expert treatment which this officer had received, and his unsatisfactory state, I advised him to submit to kidney decapsulation, and this was done by Sir D'Arcy Power on August 8, 1919. The capsules of the kidneys were rather difficult to remove, splitting a good deal in the process. The surface of the organs was a little rough, and small fragments of the cortex came away during the process of decapsulation. A small piece of one of the kidneys was removed for microscopical examination. Dr. Geoffrey Evans kindly undertook this for me and reported on the sections as follows: "The sections are of a small piece of the cortex of the right kidney fixed in formol-Müller, embedded in gelatin and cut frozen. The capsule had been previously stripped, and does not therefore appear in the section. The interstitial tissue is markedly swollen with œdema, and in it are small scattered areas of small-cell infiltration. There is some increase of fibrous connective tissue. The vessels are relatively normal, but in several afferent arterioles there is a fatty obliterative endarteritis such as is typical of diffuse hyperplastic sclerosis (? 'arterio-capillary fibrosis'—T. H.), while the capillaries of the tufts show varying degrees of hyaline degeneration with fatty change. The most marked pathological change is a proliferation of the epithelial cells of Bowman's capsule, in which both parietal and visceral layers are involved, leading to adhesion of the two layers in part of many glomeruli. All glomeruli are more or less affected: in those more damaged there is a periglomerular fibrosis; a few have undergone atrophy and fibrosis. The tubular epithelium shows, in general, a certain degree of cloudy swelling and desquamation and local fatty degeneration. There is no vascular engorgement. The changes appear to be recent. The interstitial tissue shares in the inflammatory process." Recovery was uninterrupted. The first week after the operation showed considerable increase in the urine secretion, rising to 60 oz. on the fifth to eighth days, and the puffiness of the face disappeared. A month after the operation, however, there was practically no change in the characters of the urine, which still contained red blood cells, leucocytes, 0·15 per cent. albumin, and a few hyaline and granular casts. The patient wintered at Malaga, and a report of the urine from Dr. Gutierrez on January 17, 1920, showed almost the same features as those just mentioned. When examined on June 7, the blood-pressure was 160-80 mm., the heart was less irritable, but still gave evidence of slight hypertrophy, the headache and night starts had gone, and the patient could walk five miles without being tired. The urine showed no change; nor did it on September 9, at which date the protein ratio of albumin to globulin was found by Dr. Mackenzie Wallis to be 9 to 1; red and white blood cells were still present, and a few granular and hyaline casts.

Case IV.—G. S., aged 18, was first seen on February 15, 1918, for Dr. Vickery. He was suffering from headaches, backache, inability to undergo any exertion, and anorexia. There had been slight œdema of the face in the early morning before the present examination, but this symptom had passed off. The patient had been discovered to be albuminuric some eighteen months previously. The urine now yielded the following characters: Amount in twenty-four hours, 32 oz.; pale yellow, clear, no naked-eye deposit, specific gravity 1020, acid, albumin 0·35 per cent.; centrifugalized deposit shows red blood cells absent, leucocytes in large numbers; hyaline, epithelial, and granular casts in large numbers. The radial artery was palpable; the systolic blood pressure was 145 mm.; the left ventricle gave evidence of slight hypertrophy; the fundus oculi was normal. This patient had received very efficient treatment before I saw him, and it was thought advisable to try the effect of bilateral decapsulation upon his renal function. This was done on March 4, 1918, by Sir D'Arcy Power. The operation and convalescence were uneventful. As œdema was not present before operation in this case, there was no noticeable change to record in the patient's appearance. But the records of the urine in respect to its abnormal features immediately subsequent to the decapsulation are of interest (*see* Table). Subsequent urine examinations always showed the presence of albumin and an occasional hyaline cast; but the albumin never reached more than 0·12 per cent., and this was after a long railway journey. (The patient was over 6 ft. in height, and "postural" effects were often to be observed in connexion with the albuminuria.) So far as the symptoms were concerned, there has been a very slow general improvement; the headaches have been less severe and less frequent, allowing of brain work, which was formerly impossible. The arterial hyper-tension fell to 120 mm.; the slight cardiac hypertrophy remained. Writing as recently as October 24, 1920, this boy's father says, "Generally speaking, I should describe him as still very slowly improving; his sick headaches are not so numerous as a year ago, and are generally milder when they come."

RECORDS OF URINE, SHOWING ABNORMAL FEATURES IMMEDIATELY SUBSEQUENT TO DECAPSULATION.

Days after operation	Amount of urine	Amount of albumin	Red blood cells	Leucocytes	Casts
	Oz.	Per cent.			
1	36	0·45	Numerous	Numerous	Fair number
2	56	0·25	A few	,,	,, ,,
3	58	0·2	Very few	Fair number	,, ,,
9	60	0·25	None	A few	,, ,,
12	60	0·18	,,	,,	A few
17	48	0·12	,,	Scanty	A few, hyaline only
19	50	0·075	,,	,,	,, ,,

(3) *General Remarks.*—These cases, and available records, suggest strongly that there is a clinical type of nephritis in which, when thorough general measures have proved unavailing, decapsulation becomes a definite indication and promises satisfactory results. This type is *subacute nephritis.* It is characterized by extensive and considerable œdema, massive albuminuria with casts, toxic symptoms of the chronic uræmic kind and an absence, or the presence in only slight degree, of cardiovascular changes. In chronic interstitial nephritis, granular kidney, and (or) the arteriosclerotic kidney, in which conditions there is general arteriocapillary fibrosis, the operation is contra-indicated, or, if undertaken, must not be expected to do more than effect improvement. In acute nephritis, especially if anuria be present, it is probably justifiable to puncture or to incise the kidney, failing general measures. The mechanism by which the effects of decapsulation are secured is unknown. It may well be by a simple process of drainage into the perinephric tissues. It cannot be entirely by the formation of new vessels, because this process takes time, whereas the results of decapsulation are immediate.

DISCUSSION.

Sir D'ARCY POWER said that Sir Thomas Horder paved the way for a discrimination between cases of nephritis which would receive benefit from stripping off the renal capsule and those in which it was not worth while to attempt any operation. He had performed the operation several times about the year 1902, at the instigation of Sir Wilmot Herringham, but had abandoned it as there was no improvement afterwards. Sir Thomas Horder's cases were much younger people and he was glad to hear the result. As regards the operation itself it presented no difficulties; he thought that both kidneys should be stripped at the same time and that the capsule should be cut away rather than left. Drainage was unnecessary, and he had not adopted it in any of the four cases. It was clear from the record of the second case that extreme œdema with ascites was no counter-indication to operation.

Mr. FRANK KIDD described four cases upon which he had operated. One of these was cured, one relapsed, and two seemed likely to be cured. He thought that the operation relieved the obstruction to the lymphatic circulation, and allowed the lymph to drain away from the perinephric tissues.

Dr. LEWIS SMITH thought that the operation was most useful in cases of subacute nephritis, and raised the question as to whether retinal changes were a contra-indication to operation.

Dr. G. EVANS suggested that a portion of the kidney should be excised for microscopical examination in all cases, so that an accurate pathological classification could be made.

Dr. GEORGE GRAHAM emphasized the importance of making chemical tests of the renal function both before and after operation.

Mr. GWYNNE WILLIAMS and the PRESIDENT both described cases.

On Transperitoneal Nephropexy.

By VICTOR BONNEY, M.S., M.D., B.Sc.Lond., F.R.C.S.

(ABSTRACT.)

THE success of nephropexy depends primarily upon whether the symptoms for which it is performed are or are not due to the ptosis of the kidney, and the popularity of the operation has waned of recent years because of its considerable percentage of failures. In certain cases it is impossible to be sure whether the kidney is the source of the pain, and for this class of case I have for the last eight or nine years performed transperitoneal nephropexy, an operation which in cases of doubt allows a thorough investigation of the abdominal organs before fixing the kidney.

The first time I performed it was, so to speak, by accident. The patient had a pelvic tumour which on opening the abdomen proved to be a prolapsed ectopic kidney, the renal vessels coming off from the aorta an inch above its bifurcation. I stitched the kidney to the psoas muscle at the level of the root of the renal vessels and the result was good.

The advantages of the operation thus became apparent to me, and since then I have performed it twenty times. All these cases made good recoveries and the results seem to be permanent. I had occasion to re-open the abdomen of one patient whose left kidney I had fixed in this way four years previously and found the organ well fixed.

But the most interesting point is that this method of approach to the kidney revealed conditions which, had the loin route been adopted, would have probably been overlooked. Thus gall-stones have been found twice, thickening and adhesion round the pylorus once, very small calculi in the pelvis of the kidney twice, and in the upper ureter once, early carcinoma of the transverse colon once, whilst unsuspected chronic appendicitis has been discovered on several occasions.

The steps of the operation as I have performed it are as follows: The incision is made either through the rectus or along its outer edge or obliquely downwards through the oblique muscles as far as the edge of the rectus. After careful investigation of all the abdominal organs the stomach and intestines are packed away by swabs. A space of posterior parietal peritoneum is thus left clear, through which the kidney may be felt or seen. This peritoneum is now incised above and parallel to the flexure of the colon and the perirenal fat having been teased apart by the fingers the lower pole of the kidney is exposed. If it is necessary to examine the kidney closely the whole of it may be freed and dislocated through the wound, but as a rule it is sufficient to bare its lower end. The index fingers now tease apart the fat until the psoas muscle is exposed. Lying in front of this in about four cases out of five is a broad aponeurotic expansion, the upper end of the psoas parvus, which forms a most suitable holding ground for two of the anchoring sutures. The lower pole of the kidney is now pulled forwards and downwards and three No. 4 silk sutures are passed through the renal substance—one on its inner side, one at its apex and one at its outer side. By means of a long-handled needle the posterior ends of these sutures are carried through the substance of the psoas muscle. They are then tied, care being taken to see that the kidney is brought directly up against the muscle without the intervention of perinephric fat. The opening in the posterior peritoneum is then sutured and the abdominal wound closed.

There should be practically no bleeding except what comes from the punctures in the kidney and this stops when the sutures are tied. The operation is simple unless the patient be fat. The left kidney is less accessible than the right.

DISCUSSION.

Mr. THOMSON WALKER considered that as the kidney was only fixed at its lower pole, there was a risk of its tilting forward. He also feared that there might be a risk of injuring the ureter.

Mr. WEBB JOHNSON considered that the lumbar approach allowed of a better examination of the kidney and ureter, and that by this method alone could firm fixation be assured.

Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

Unilateral Hæmorrhagic Interstitial Nephritis with Slight Hydronephrosis.[1]

By ZACHARY COPE, F.R.C.S.

A RIGHT kidney removed from a woman aged 36. For a month the patient had suffered from continuous painless hæmaturia. The bleeding became copious and caused serious anæmia. Examination showed an enlarged left kidney, but examination by cystoscopy and ureteral catheterization proved all the blood to be coming from the right kidney. The secretion of the left kidney was normal. No evidence of stone was seen by X-rays. On exposure of the right kidney it was seen to be hydronephrotic. No tumour nor stone was found. Nephrectomy was performed. Uneventful convalescence. Section of the kidney showed very distinct and general interstitial changes with many hæmorrhagic patches easily visible to the naked eye.

Microscopical section shown.

MICROSCOPICAL REPORT ON THE SPECIMEN BY STANLEY WYARD, M.D.

The most striking feature of the specimen is the extreme fibrosis which affects all parts, but not equally. In the cortex there are areas in which the tubules are practically normal in appearance being merely separated by some excess of fibrous tissue. Elsewhere the tubules are widely separated and almost or completely destroyed, the fibrous elements being predominant. In the medulla the fibrosis reaches its greatest development so that the tubules are few and far apart. Many are occluded so that they are seen as mere cords of epithelial cells. The vessel walls are very greatly thickened, the tunica media especially. Numerous hæmorrhages into the cortex, all interstitial, have occurred. In no case is any blood found in the lumen of a tubule. The tubular elements have been largely destroyed and in many cases replaced by bands of fibrous tissue. The distal portion of the tubule appears to have suffered most. The glomeruli are not fibrotic and appear healthy. Bowman's capsule is normal and there is no proliferation of its cells. The convoluted tubules similarly appear little affected, but it is probable that this is true only of the first convolution and that many of the second convolutions are involved with the other portions. The brunt of the disease has fallen upon the loops of Henle, especially the descending limb which is often occluded by a hyaline plug. The collecting tubules are sometimes dilated, sometimes compressed and obliterated. The condition, therefore, is one of interstitial fibrosis together with destruction of the distal portion of many of the urinary tubules. Many of the other tubules are rendered inefficient either by compression from without or by exudate into their lumen. Only a few—comparatively speaking—remain patent throughout their length.

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[1] At a meeting of the Section, held November 25, 1920.

Hæmato-nephrosis due to Papilloma of the Renal Pelvis.

By Zachary Cope, F.R.C.S.

A left kidney removed from a female patient, aged 43, who for eighteen months had suffered from intermittent painless hæmaturia. Bleeding often brought on by exertion. Examination showed both kidneys somewhat enlarged, the left larger than the right. They were freely mobile. Cystoscopy showed that the blood was coming from the left kidney. A short time before operation the hæmaturia ceased, the left kidney became larger and painful, and cystoscopy showed that nothing was coming down the left ureter. Secretion from the right kidney normal. At operation the left kidney was found to be greatly enlarged and dilated. It was incised and found full of altered blood—about two pints. The cause of obstruction was discovered to be a sessile papillary growth in the renal pelvis blocking up the uretero-pelvic junction. Nephrectomy. Uneventful convalescence.

Four Cases of Growths of the Ureter.

By J. W. THOMSON WALKER, F.R.C.S.

CASE I.—PAPILLOMA OF THE URETER; HYDRONEPHROSIS; NO URINARY SYMPTOMS; NEPHRECTOMY; URETERECTOMY.

J. E., AGED 64 (March 9, 1918) was sent to me by Dr. John Adams. He complained of swelling of the abdomen. Eight months previously he noticed a lump in the right side and this has continued to increase in size. Four years ago he had hæmaturia for two months but there had been no recurrence. If he walks or sits for a long time there is a little pain under the ribs and in the right groin. He had lost weight for twelve months (about 12 lb.). The urine was normal.

On examination a huge elastic swelling occupied the right side of the abdomen obliterating the waist line and bulging out as a great rounded mass from under the right costal margin and overlapping the crest of the ilium. The most prominent point was at the level of the umbilicus in the line of the nipple. The swelling was rounded, smooth and elastic, and tense. It extended 4½ in. to the left of the middle line at the level of the umbilicus, and vertically in the mid-line from 2½ in. below the ensiform cartilage to within 1 in. of the pubic symphysis. There was absolute dullness on percussion except at a small area below the umbilicus. On bimanual palpation the swelling could be felt bulging backwards in the loin and all its surfaces were rounded. The liver dullness rose as high as the right nipple.

Cystoscopy showed a normal bladder and normal ureteric orifices. Upon injection of indigo carmine a copious deeply stained efflux was seen on the left side in fifteen minutes. No efflux appeared on the right side. A diagnosis of closed hydronephrosis was made.

On April 13, 1918, I operated at St. Peter's Hospital and exposed the kidney by a curved lumbar incision. The peritoneum was reflected with some difficulty, being firmly adherent to the anterior surface of the swelling. The hydronephrosis was tapped and 6½ pints of dark brown fluid were collected but several pints escaped. Dissection of the cyst wall of the ascending colon and the second portion of the duodenum was difficult. A good vascular pedicle was isolated and ligatured.

Up to this time there was nothing to distinguish the hydronephrosis from the type usually found with valvular formation or stricture at the pelvic outlet. On clamping the ureter, however, the forceps crushed through it and a portion of it came away. On examining the ureter more carefully, it was found that the lumen was blocked with papillomatous material and that the wall was very thick and friable. A thick ureter was felt as far down into the pelvis as the hand could reach.

The operation had already lasted nearly two hours and I did not consider it wise to proceed at once to removal of the ureter. The ureter was ligatured and dropped into the abdomen, and the abdominal wound closed.

On examining the hydronephrosis from within, a small bud of papilloma could be seen appearing at the pelvic outlet filling up the orifice. The hydronephrotic sac was not otherwise peculiar.

The patient made a good recovery from the operation and three months later came in for operation on the ureter.

On July 18, 1918, I performed ureterectomy through a median vertical incision below the umbilicus. The peritoneum was pushed up from the pelvis and right iliac fossa. Some difficulty was encountered in stripping the peritoneum from the internal abdominal ring, the site of an old strangulated hernia. The ureter was much thickened and was densely adherent to the common iliac vein and artery, and in the pelvis to the internal iliac vessels. It was detached from above downwards and the lower 1 in. was found to be normal. The ureter was clamped and tied at the bladder wall. The abdominal wall was repaired and a drainage tube placed in the pelvis.

On examination of the specimen of ureter removed, it was found that there was a papillomatous mass growing from the mucous membrane of the upper 1½ in. and covering the whole of the mucous surface. This is prolonged downwards as a fleshy wormlike mass, the thickness of the little finger, growing from the mucosa and reaching to within 1 in. of the lower (vesical) end of the specimen, and ending in an oval mass. On the mucous membrane of the lower 1 in. there are some smaller papillomata.

The pathological report on the growth is as follows: "The ureteral growth is composed of villous processes of much thickened transitional epithelium supported on a delicate and vascular connective tissue core prolonged from the submucosa. The base of the growth is well defined and there is no tendency to deep infiltration. It is a simple villous papilloma."

CASE II.—PAPILLOMA OF THE GALL BLADDER AND URETER; HYDRONEPHROSIS; URETERECTOMY.

R. S., aged 38. Examined November 20, 1918. Complained of blood in the urine of six years' duration. The blood was small in amount at first and of occasional occurrence, but had lately appeared more frequently and in greater quantity. It appeared on exposure to cold or after exertion, and he has passed clots. General health good, but for the last month has noticed a swelling in the right side of the abdomen.

Examined in a London hospital in April, 1914. No growth of the bladder visible on cystoscopy. On examination a large mass was palpated, situated in the right side of the abdomen and right loin. The swelling was not tender. It moved freely with respiration, reached back into the loin and could be moved between the two hands. It extended across the middle line at the level of the umbilicus and above this and downwards almost to the iliac crest. The surface was smooth but the outline irregular and the consistence firm and elastic. A semi-tympanitic note was given on percussion over the anterior surface of the swelling.

Cystoscopy was attempted but the bladder was full of masses of clot. The clot was removed with an evacuating cannula but some of it still remained at the right side of the base. The left ureteric orifice was normal. The left ureter was catheterized to 6 in. and a free flow of urine obtained. Phenolphthalein was injected and the urine of the left kidney became coloured in seven minutes and contained 37 per cent. of the dye.

On December 13, 1918, right nephrectomy was performed. The loculi of the cyst were tapped and a large quantity of brown blood-stained urine removed. The ureter was clamped and tied at the lower pole of the kidney. After removal of the hydronephrosis a small papillomatous growth was found in the upper end of the ureter at the uretero-pelvic junction. The hydronephrotic sac showed no other unusual features.

The patient made a good recovery and was discharged on January 10, 1919. Hæmaturia still continued and was almost constant. He was directed to return for ureterectomy.

Patient was readmitted on January 26, 1919, having had hæmaturia until about January 12. Cystoscopy showed a large papilloma obliterating the orifice of the right ureter and another papilloma near it.

February 28, 1919: Operation, ureterectomy. A median vertical incision was made from the pelvic symphysis to the umbilicus, and extended later to the right of the umbilicus for about an inch. The peritoneum was displaced very easily from the bladder and right side of the pelvis. The ureter was found thickened to the girth of the thumb. The vas deferens and its vessels and the spermatic vessels were recognized and displaced. There was difficulty in reaching the upper end of the ureter which was firmly adherent, and a pedicle at the upper end was clamped and ligatured. At the lower end the ureter was fully exposed and the adjacent bladder cleaned. An incision was made through the bladder wall about ½ in. in front of the ureter and a large mass of papilloma found projecting from the ureteric orifice into the bladder and another large papilloma close to it. A portion of the bladder wall surrounding the ureteric orifice and bearing the papillomata was removed with about 1 in. of bladder wall all round the ureteric orifice. The bladder wound was then stitched from without and a large drain introduced down to the bottom of the pelvis. A catheter was tied in the urethra. The patient made an uninterrupted recovery.

The specimen shows the ureter split along its anterior surface and spread out to within ½ in. of the bladder wall. The whole of the mucous membrane is covered with a low growing shaggy papillomatous carpet. This growth is more thickly set and the papillomata higher in the lower 1½ in. of the split ureter. The lower portion of the specimen consists of about ½ in. of unopened ureter and a portion of bladder wall. The ureteric orifice is obscured by masses of papillomata, one of which projects from the ureteric orifice and the others are arranged round it.

Case III.—Papilloma of the Ureter; Partial Ureterectomy.

J. B. A., aged 63. Examined June 22, 1920. Two years ago began to have slight difficulty in micturition and had to pass urine once at night. Hæmaturia occurred at intervals and between the attacks the urine was clear.

In June, 1919, the surgeon who sent him to me performed prostatectomy. The prostate was not large and the middle lobe was the cause of the obstruction. The histological examination showed innocent enlargement. He was well till August, 1919, when the hæmaturia recurred and since that time he has had many attacks, and recently one very severe attack.

I examined him on June 22, 1920. He was a stout, rather flabby, man of 15 st. weight. There was no pain nor discomfort. The frequency of micturition was three hours during the day and twice at night. There was no urgency nor difficulty in micturition apart from the passage of clots. The clots he had passed were of the shape of a small eel. There were a few drops of light blood at the beginning of micturition and then the urine became clear.

On cystoscopy a growth the size of a pea was seen projecting from the right ureteric orifice and alongside this blood oozed from the ureter.

Operation June 25, 1920: Partial ureterectomy and implantation of ureter in bladder. The bladder was opened and the patient placed in the Trendelenburg position. A curved incision was made through the bladder wall about 1½ in. above and behind the right ureter. A flap of bladder wall including the right ureteric orifice was turned down. In the perivesical tissue exposed by this incision, the lower end of the right ureter was isolated. The ureter was normal on palpation at this spot, and as high as the finger could trace. The duct was cut across 2 in. from the orifice. After the upper end of the ureter was freed the edges were stitched to the lips of the wound in the bladder base with three catgut stitches. The flap of bladder wall was now reflected further and a portion of bladder wall including the right ureteric orifice was removed together with the lower 2 in. of ureter and the ureteric growth. A small tube was placed alongside the new ureteric orifice passing through the bladder wound into the perivesical tissue and the bladder wound closed up to it with interrupted catgut stitches. A large tube was placed in the cystotomy wound. The patient made a good recovery.

The following is the report on the specimen: "The specimen comprised about 1½ in. of the ureter with the bladder wall surrounding its orifice. At the orifice of the ureter and projecting from it into the bladder is a small soft villous papilloma. There is no evidence of growth higher in the ureter."

CASE IV.—HYDRONEPHROMA OF KIDNEY, SECONDARY GROWTH OF URETER; NEPHRECTOMY.

F. S., aged 53, a patient of Dr. MacDougal, of Wallington, was examined on July 5, 1920. For four weeks he had suffered from scalding on micturition and from hæmaturia. The onset was sudden and the hæmaturia was continuous, although it varied in amount. Clots had occasionally been passed, but their shape had not been noted.

There was pain in both testicles. A few nights before I saw him he had an attack of retention relieved by catheters. I cystoscoped him on July 5, 1920. The bladder and right ureteric orifice were healthy. A slow stream of treacly black blood trickled slowly from the left ureter.

On admission to King's College Hospital (July 15, 1920), the patient was pale and weak with blanched mucous membrane. There was nocturnal frequency of micturition and occasional difficulty due to the passage of clots. The left kidney was palpable. The urine was acid, specific gravity 1020, and it contained albumin, blood, and some pus, and a few casts. Worm-like clots were passed. An X-ray examination showed the shadow of an enlarged left kidney. A catheter passed up the right ureter for 12 in. without obstruction. On the left side the catheter was arrested at 6 in. from the meatus and dark blood flowed from it in quantity. Urea concentration test (July 21, 1920) for both kidneys was 2 per cent. for the second hour; for the right kidney (July 29, 1920), 1·47 per cent. Pyelography showed an indefinite round pelvic shadow without characteristic abnormal features.

Operation (August 10, 1920): Left nephrectomy. Ureter clamped and ligatured at level of lower pole of kidney. Kidney showed hypernephroma, round in shape and embedded in the upper half of the kidney. Renal pelvis distended with blood clot but otherwise normal. Hæmaturia ceased, and he made a satisfactory convalescence, rapidly gaining weight and his colour improving.

On September 28 an attack of hæmaturia occurred, without pain or discomfort. The urine was still blood-stained five days later, but cystoscopy showed only a slight degree of cystitis. Urea concentration test of the right kidney after the operation was 1·95 per cent. (August 16, 1920) and 2·06 per cent. (September 3, 1920).

On November 14, 1920, he was readmitted, suffering from severe hæmaturia, which had appeared four weeks after leaving the hospital. On cystoscopy a clot of blood was seen projecting from the left ureter. The patient was suffering from profound anæmia and the urine contained a large quantity of blood.

Operation (November 16, 1920): Left ureterectomy. The patient was so profoundly anæmic that it was doubtful whether an anæsthetic could be safely administered. He bore the operation and the anæsthetic well and had little shock. After the operation the hæmaturia ceased.

The specimen of the left ureter showed a small growth about the size of a split pea at the upper end, and two blood clots along its course. The patient is making a good recovery.

Two Cases of Papilloma of the Kidney.

By S. G. MacDonald, F.R.C.S.

Case I.

The first specimen consists of a hydronephrotic kidney. A large papillomatous growth is seen in the dilated pelvis and flat growth of the same type is visible on various portions of the epithelial surface of the dilated kidney. In one place the kidney substance has been invaded by growth, but the latter appears to be confined to the kidney, and the outer aspect of the organ is smooth.

Clinical notes: The patient (C. W. K.) was a male, aged 56. The first and only symptom was hæmaturia, which began on July 10, 1919, while cycling, and continued intermittently, with the occasional passage of clots, until he was seen by me on September 26, 1919. At this time there was a large smooth swelling in the position of the right kidney. Cystoscopy revealed nothing abnormal, the left ureter was catheterized and the corresponding kidney found satisfactory. On October 11 the right kidney was removed with all the perirenal fat, by the lumbar route. There was no apparent extension of growth beyond the kidney, nor could any glands be felt. The patient made an uneventful recovery.

For the pathological report I am indebted to Dr. Elworthy " . . . kidney laid open to show villous formation involving the renal pelvis and upper end of ureter. Microscopically these growths were considered simple in nature, but serial sections made through a fragment taken from the region of the hilum of the kidney (where the growth had invaded the kidney substance) showed in the majority small areas of cells, the appearance of which pointed to malignancy. The residual renal tissue showed changes due to pressure and inflammation. The perirenal tissues did not appear infiltrated."

Subsequent history: On October 14, 1920, the patient was seen again by me. He had four nodules of growth in the skin over the lower part of the thoracic wall, the nearest being 2½ to 3 in. from the operation scar. There was no evidence of deeper growth, and the scar itself was healthy. On October 16 I excised the area of skin containing the nodules. Dr. Elworthy's report on these is: "Allowing for differences of staining the nodules seem to be secondary to the renal growth. The structure is 'villoid,' and its cells appear to have been derived from an original transitional epithelium. In a few places some of the cells suggest reversion to a squamoid type."

CASE II.

The second specimen, unfortunately not so well preserved as the former, shows a pyonephrosis with a large papillomatous growth occupying the renal pelvis; similar masses of growth are seen springing from the epithelial lining of the calices, but in this specimen there is no invasion of renal tissue.

Clinical history: E. M. M., male, aged 40, first seen by me on September 10, 1919. He gave a history of hæmaturia dating from 1912, and recurring at intervals of six to twelve months. During 1919 patient began to suffer from intermittent and painful micturition. For the last seven months he also suffered from right renal pain. Examination revealed a palpable but not grossly enlarged right kidney, and the urine contained blood and pus. X-ray examination was negative, but cystoscopy disclosed a large growth of doubtful nature, occupying the right side of bladder and obscuring the right ureteric orifice. It was thought that the enlargement and probable infection of the right kidney were secondary to the obstruction produced by the growth. On November 21 the bladder was opened and the growth excised; recovery was uneventful.

Microscopy (Dr. Fletcher) showed a villous papilloma, but there was no evidence in sections of the growth or pedicle that it had taken on malignant characters. I saw the patient at intervals until March, 1920, by which time the right kidney had increased in size and was becoming more painful and tender. The urine contained more pus, and there was fever at night. Cystoscopy showed a purulent efflux from this kidney, the left ureter was catheterized, and this kidney proved efficient and uninfected.

On March 26, right lumbar nephrectomy; there were few adhesions, and the kidney was removed intact. Patient again made an uneventful recovery, but unfortunately has some recurrent growths in the bladder.

Microscopy of renal growth (Dr. Fletcher): "The kidney was enlarged by a big soft flocculent growth involving the middle zone and apparently arising from the renal pelvis. The upper and lower poles of the kidney were hydronephrotic. On examination the kidney proves to be involved only by pressure, and is not invaded in the true sense. I regard the growth as histologically innocent, and it seems probable that the villous tumour of the bladder previously removed was a simple implantation growth from the pre-existing renal pelvis growth."

Case of Angeioma of Kidney.

By R. H. Jocelyn Swan, O.B.E., M.S.

A. S., aged 19. Sudden profuse hæmaturia without any preceding pain arising on November 2, 1911. Urine bright red and contained rounded worm-like clots. Hæmaturia continued profuse. When seen on November 4, urine passed contained bright red blood which clotted in the vessel. Patient was very pale and blanched. Pulse 120, small. No pain of any sort. No frequency of micturition.

Cystoscopy: Bladder washed clear very quickly and blood seen issuing from left ureter with forcible jets.

Operation: Kidney exposed and appeared normal, except that pelvis was dark from contained blood. Kidney divided in length, when a spongy mass was seen in central part, oozing blood freely from surface. Nephrectomy.

Microscopical section: The renal tissue is infiltrated with blood around an area showing the structure of an angeioma.

Double Ureter; Hydronephrosis of one part of a Double Kidney.

By R. H. Jocelyn Swan, O.B.E., M.S.

S. D., aged 33. Constant pain in left side of back for fourteen months, dull aching in character; no colic. Not affected by rest or exertion. No increased frequency of micturition.

On examination: Whole of left side of abdomen shows definite resistance; abdominal muscles held contracted and examination difficult.

Percussion note dull in whole of left side to 2 in. from middle line, extending into loin which is slightly bulged. Urine 1010; no albumin, pus nor blood.

Cystoscopy: Bladder normal. Left orifice small. Attempt at catheterization of ureter failed. Right orifice normal.

Operation, November 14, 1907: Vertical incision in left abdominal wall; mass discovered to be a hydronephrotic kidney. Parietal peritoneum stripped up, exposing tumour extraperitoneally, and separation easily made above. Renal vessels found crossing the front of cyst and ligatured, when tumour was found to consist of a very large cyst with a flattened kidney above and outside it. Below, however, a double ureter was found, one enormously dilated and tortuous from the cyst, and the other small and passing vertically from the flattened kidney. These two ureters united below just before entering bladder. Ligatured and whole removed.

Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

Angioma of Kidney.[1]

By R. H. JOCELYN SWAN, O.B.E., M.S.

I SHOWED this specimen at the last pathological meeting of the Section, and the Secretary asked me to bring it forward again, in the hope of creating some discussion upon it.

It occurred in a young Cambridge undergraduate, aged 19. On October 30, 1911, he played football; he did not remember any particular kick or other injury, but when passing urine three days later he was surprised to notice it was thick with blood. He had had no pain. The doctor stated that in the water there was a worm-like clot 2 in. long. Such a distinctive clot was only present on one occasion. He continued to bleed severely during November 2 and 3. Sir Clifford Allbutt saw him on November 4, and thought he must have a villous growth of the bladder, and advised that the bladder should be opened forthwith in order to stop the hæmorrhage. I saw him on the same evening when he was still passing bright red blood, so much that it clotted in the vessel into which he passed it. He was very anæmic, obviously from the bleeding, the pulse was 120 and small, and his general condition was not good. I washed out the bladder rapidly, and got a view of blood pouring out of his left ureter. There was no growth in the bladder. He was given an anæsthetic and I rapidly exposed his left kidney, which, to outside inspection, appeared normal. However, the pelvis and ureter were plum-coloured and evidently contained blood. I split the kidney vertically, and found a tumour close to the pelvis of the kidney oozing blood freely and looking like erectile tissue. It was impossible to remove it separately from the kidney, therefore I did nephrectomy. The patient did very well and made an uninterrupted recovery.

The specimen in the jar you have seen, but I wish to show you, by the epidiascope, a drawing which was made within a few hours of the removal by Mr. Shiells. You see in the substance of the kidney an oval tumour with spongy texture with rather large vessels and spaces above. The pelvis of the kidney is stained with blood. The other side became somewhat damaged by cutting into the kidney and by the bleeding. The microscopic section of the tumour was made by Dr. Kettle, who reported that it was an angioma showing definite dilated capillaries.

There is a section under the microscope which Sir John Bland-Sutton has examined and he tells me that he has no doubt it is cavernous angioma.

The chief interest in the case lies in its rarity; German authorities seem to consider that angioma of the kidney may exist with adenoma. It is difficult to find a report of any case in England; Mr. Thomson Walker does not mention it in his book. The only similar recorded case I can find is in Sir Henry Morris's book and his case had a very definite hæmaturia.

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[1] At a meeting of the Section, held February 24, 1921.

He states that a woman aged 23 was seen for cellulitis of the neck and suppurative cellulitis of the right leg. In addition she had profuse hæmaturia and slight pyuria with left lumbar pain; she gave a history of having had previously, over a period of some years, several attacks of hæmaturia, with pain in the left loin, each attack lasting on an average three to four days. She died after eleven days from septicæmia. At the post-mortem, the cause of the hæmaturia was found to be multiple angiomata of the left kidney, one of which had ulcerated into the upper calices. There was no calculus. There were areas of red spongy tissue in the renal substance, rather in the medullary than in the cortical portion. To the naked eye, the cut surfaces showed the open mouths of two or three large vessels with a wide zone of cavernous tissue surrounding them. Microscopically, these areas were composed of a collection of vascular spaces, as in an angioma. (Morris, "Surgical Diseases of Kidney and Ureters," i, p. 630.)

Allen and Cherry state that "true angioma of the kidney may show all grades of capillary dilatation until networks of inter-communicating vascular spaces are formed." (International Medical Congress of Australasia, 1897.)

Mr. Deanesly, of Wolverhampton, was good enough to write to me about a case under his care in September, 1906, which he has kindly given me permission to quote.

A man, aged 66, had for five months suffered from pain in the left kidney region and intermittent hæmaturia. When seen the urine was full of blood. There was no note of a cystoscopic examination. The left kidney was exposed by lumbar incision and separated from loose fatty tissue. On its surface were numerous projecting rounded nodules about ½ to ¾ in. in diameter and of a dusky vascular appearance. One of these was removed for microscopical examination. The ureter and pelvis were normal and no calculus was found. The kidney was not removed. The patient was known to be well in 1908, except for occasional pain and hæmaturia.

The specimen was examined by the late Mr. Targett who reported "the greater part of this nodule in the kidney has the structure of a capillary angioma and is well surrounded by a thick fibrous capsule. Alongside is an area of closely packed gland tubules with very little stroma and at the periphery of the section the kidney substance exhibited the results of chronic interstitial nephritis."

DISCUSSION.

Mr. **Ralph Thompson** said that if these were ordinary angiomata, there was one feature which was very interesting. In the case published by Sir Henry Morris, and mentioned by Mr. Swan, there was ulceration, and in Mr. Swan's own case there was some destruction of renal tissue. He did not think that was common in the case of angiomata occurring elsewhere in the body. No doubt ulceration did occur over nævi and angiomata, but was there consequent loss of tissue *qua* the angioma? The feature of ulceration seemed to suggest there was something besides angiomatous material present, even though the microscope might not reveal it. Another point which arose in this discussion was, as to whether grave hæmorrhage was a clinical symptom in bladder conditions. He was aware that such patients might become pale, but was there in these conditions the danger to life consequent on the hæmorrhage which was found in kidney conditions? In the latter, one saw, from time to time, patients arriving in the last stages of collapse, but in ten years he had never seen really serious hæmorrhage arising from bladder disease, though one case of the kind was reported to him at Guy's Hospital. Therefore, was Sir Clifford Allbutt sufficiently justified, because of the bleeding, in suggesting that the hæmorrhage was of vesical origin?

Mr. **Frank Kidd** said that when he was doing post-mortem work at the London Hospital, which he continued for some years after he qualified, he was often surprised to find how common were simple tumours of the kidney. He collected a number of specimens of them, which he cut. In the kidneys of people dying of other diseases it was usual to find fibromata, adenomata, and papillo-cystic adenomata in the kidney. Yet in 2,500 post-mortems he never saw a case in which such simple tumours had caused symptoms. He had always looked out for nævi of the kidney, because Mr. Hurry Fenwick had described in one of his books several cases of angioma of the renal papillæ encountered at operation, but he had never previously seen an undoubted specimen. He had met with two cases of infection of the kidney with gonococci; both exhibited grave unilateral hæmaturia. In one he had to remove the kidney because the patient was obviously about to die from hæmorrhage. In the other case he managed to stop the bleeding by washing out the kidney with silver nitrate, and in both gonococci could be found in the urine which was drawn off from the bleeding kidney. He had published a full account of the microscopic appearance of the first kidney in his book "Common Infections of the Kidney," p. 278, *et seq.* When cut it showed a curious condition of dilatation of the veins round the papillæ, and the collecting tubules were dilated and cystic from inflammatory products. It was clear that the man suffered from hæmorrhage because he was bleeding from these veins. Recently he saw a paper by Buerger (*Medical Record*, 1918, xciv, p. 1057) describing inflammatory kidneys, not gonorrhœal, with similar changes that had caused severe hæmaturia. It had been suggested that Mr. Swan's case was an inflammatory condition and not one of simple tumour formation, but the sections from his case were quite different from those of the gonorrhœal kidney; there was no evidence of dilatation of tubules with inflammatory products, nor was there evidence that that patient had suffered previously from inflammatory trouble. It was of the utmost importance to try to find out further causes of unusual hæmaturias. He had a great dislike to the term "essential hæmaturia." It was a confession of ignorance to use it and it tended to obscure judgment and hinder research. In the present case Mr. Swan had shown a well-proved case of simple tumour of the kidney which could produce a clinical symptom, namely, grave hæmaturia.

Mr. THOMSON WALKER asked if a better name than "essential hæmaturia" could be suggested. As an author he confessed it was a bad name, but it was difficult to find a better.

Mr. KIDD: Hæmaturia of unknown origin would do.

Mr. CURTIS remarked that of course it was easy to be wise after the event, but he would like to know whether Mr. Swan thought nephrectomy essential in such a case, or whether, if an angioma was diagnosed, less drastic treatment, e.g., by the cautery, might not suffice; in other words, was it to be laid down in future that nephrectomy was the correct treatment for angioma?

The PRESIDENT said he supposed it would be agreed that the word hæmaturia was not used as indicating any particular disease: it was only a symptom. If cystoscopic examination revealed nothing wrong in the bladder and nothing was issuing from the ureters, the difficulty was to find what was the cause of the trouble. One did not like to explore the kidney unless something was evident which rendered that justifiable. Therefore he thought the general practice was to wait for a time to see whether the hæmaturia continued, and whether it could be arrested by medicine and rest. With regard to Mr. Ralph Thompson's remark, he (the President) had seen hæmorrhage from growths in the bladder which was as severe and serious as from the kidney. There were cases of such profuse bleeding from the bladder that a view of the conditions present could not be obtained until the cystoscope had been used on several occasions.

Mr. THOMSON WALKER said he had seen a good number of cases in which bleeding from the bladder was so severe as to make him anxious. The point of difference was, that when the bladder bled severely it became filled with clot, and it was then necessary to open the bladder, whereas bleeding from the kidney might go on longer without interference; the anæmia would therefore be more profound.

Mr. JOCELYN SWAN (in reply) said he was inclined to agree with Mr. Thompson's remark that the severe hæmorrhage justified the attribution of it to the kidney; he had never seen any bladder hæmorrhage cause such a grave condition as that in which this patient had been; he was exsanguinated, with a very feeble pulse, and he was getting to the cold stage, with sweating. He ventured the opinion at the time that he had never seen a bladder condition bleed to such an extent as to endanger life. In other cases, too, he had seen very severe hæmorrhage in kidney conditions. As Mr. Thomson Walker pointed out, in bladder conditions the patient could tolerate the bleeding better, and the intravesical clotting tended to arrest the hæmorrhage. The presence of an excessive amount of clot in a distended bladder would cause pain and constant desire to micturate. He had seen severe hæmorrhage from prostatic trouble, but not to such an extent as to make death appear imminent. Where there was such severe hæmorrhage without pain it was more likely to be renal than vesical in origin and therefore that was a point in diagnosis. The fact that Mr. Kidd had found simple tumours of the kidney quite commonly in the post-mortem room without any clinical evidence corresponded with the statement of pathologists that adenomata and fibromata were quite common in the kidney. In this case a simple tumour had given rise to such profuse hæmaturia as to endanger the life of the patient, which was very uncommon. He was glad to hear Mr. Kidd raise the point concerning Mr. Hurry Fenwick's cases of angiomata of renal papillæ. That was a different condition. In Mr. Swan's case there was a distinct tumour in the renal substance. He had no evidence of this being an infective kidney; there was no suggestion of gonorrhœa, nor was there any preceding inflammatory trouble. When Mr. Curtis asked whether nephrectomy was necessary in such a case, he was fully justified in his question; if its nature had been known, treatment by cautery or diathermy might have been successful. In some cases of localized tumour in a more favourable position, simple excision of the tumour might be sufficient. But this patient's condition was so grave that something had to be done at once in order to save his life. He was in a small nursing home, where no cautery nor electrical apparatus were available. Mr. Swan admitted that when he decided to remove the kidney, he did not know the functional condition of its fellow, but he had to take that risk. The President's remark that hæmaturia was a symptom, not a disease, was very much to the point, and it was for those working in this specialty to discover the causes of cases hitherto classified under the name "essential hæmaturia." He also objected to that term, as he did to "idiopathic hæmaturia." He was very glad this discussion had taken place; it showed that this type of case was at least a very unusual one.

Melanotic Sarcoma of the Kidney.

By PHILIP TURNER, M.S.

THE patient, a married woman, aged 30, with four children, from whom this specimen was taken, was admitted into Guy's Hospital in October, 1919, for abdominal pain, vomiting, and constipation. There was a tuberculous family history, and the patient had one eye removed three years before for what she described as "tuberculous trouble." Signs of phthisis were found at the left apex.

The day before admission she had a sudden and violent attack of pain in the right hypochondrium associated with vomiting and constipation. There was rigidity and tenderness on the right side of the abdomen, well-marked visible peristalsis was present on the left side, and on bimanual examination a vague tumour was detected on the right side below the liver. The urine was normal. The case was considered to be one of either acute cholecystitis or of appendicitis, but when the abdomen was opened a large retroperitoneal hæmatoma was found at the back of the abdominal cavity on the right side. The maximum amount of clot was behind the hepatic flexure of the colon obscuring the kidney, but it extended downwards to the iliac fossa and internally to beyond the midline and into the root of the mesentery. There was no free blood in the peritoneal cavity, and no cause for the hæmatoma could be found. The hæmorrhage was thought to be due either to a retroperitoneal growth or, possibly, to a leaking abdominal aneurysm.

The patient did very well after the operation, and was discharged in about a month's time.

Nothing more was heard of the patient until the beginning of December, 1920, when I was asked by Dr. E. Milton to see her. She was then complaining of pain in the right loin: there had been a little hæmaturia and slight pyuria which had cleared up with rest and medical treatment. She looked thin and ill, and on examination the right kidney, which could be easily felt, was considerably enlarged, with a distinct boss towards the lower pole. It was decided to operate, and the tumour was approached by an incision in the right semilunar line. The kidney was removed, but the patient died shortly afterwards of shock and hæmorrhage. The tumour was at first sight thought to be an angioma, but further examination showed that it was a black growth. Histological examination by Dr. G. W. Nicholson showed that it was a melanotic sarcoma. No post-mortem examination was made, so it is not possible to say whether there were any other melanotic growths. Presumably the primary growth was in the eye which had been removed some four years previously, but, unfortunately, neither the hospital nor the name of the operator are known.

DISCUSSION.

The PRESIDENT said that Mr. Turner had given a clear and succinct description of the case. He asked whether, when the kidney was removed, the disease had extended to the surface, or was it confined within the capsule? It must have extended into the capsule when the bleeding occurred.

Mr. C. A. R. NITCH said that at the present time he had under observation a patient, aged 39, who one year ago, had a pigmented mole on his back, which suddenly took on rapid and malignant growth. It was removed, and found to be melanotic carcinoma. Four months later, he developed a large gland in his axilla, and when that was removed it was found to contain metastatic growth. Two months ago, the axillary glands again became enlarged. Excision was not then considered advisable, as Mr. Nitch thought the enlargement was due to secondary growth, and did not feel sure that an operation would confer any benefit. He therefore sent the patient to the Radium Institute to be irradiated six hours daily for five days. As the axillary glands did not subside, Mr. Nitch decided to excise them. The patient mentioned that he had had hæmaturia, but no pain. When the glands were removed, a cystoscopic examination was made, but as the hæmaturia had then ceased, it was impossible to ascertain its source. The bladder was quite normal. One of the glands removed contained a dark deposit, which was found to be blood-clot, not secondary growth. Three weeks ago, the patient reported that hæmaturia had recurred, and therefore he probably had a secondary melanotic growth in the kidney.

Mr. JOCELYN SWAN said that a case admitted under his care at the Cancer Hospital a month or two ago was in some respects similar to that described by Mr. Turner, but a more advanced case of general sarcomatosis. The history given was that two years eight months previously the man had had his eye removed for malignant tumour in a hospital in America; he did not know what the actual condition was. When admitted into the Cancer Hospital he was very ill: he had nodules of growth on the parotid and submaxillary areas, one side of the chest was dull, the liver enlarged and nodular, and there was œdema of legs and scrotum. He died ten days after admission. At the post-mortem scarcely any viscus was free from nodules of growth, but the amount of pigment was only small. In the liver and kidney there were large whitish nodules. He had had hæmaturia, and there was growth in both kidneys. Some years ago he had a case of melanotic sarcoma of the foot. There were also melanotic glands in the groin. She died of melanotic sarcomatosis. There was a large secondary deposit in the adrenal gland. not in the kidney; a big mass sat on the top of the kidney, and it should be labelled adrenal secondary deposit. His own experience was that in these cases there were secondary deposits in other viscera, and he asked Mr. Turner if there was any subsequent evidence of metastatic growth in any other organ.

Mr. FRANK KIDD supported Mr. Swan's statement. In dealing with growths one met with one type which led to multiple deposits all over the body, whereas in another type secondary deposits might be confined to one organ. One could never tell in any particular case how long it would be before there would arise evidence of recurrence. For instance, he had known a breast removed without including the pectorals, and had seen carcinoma develop fourteen years later in the glands of the axilla—i.e., deposits of growth might lie dormant in the body quite a long time without producing symptoms. He recalled two cases in which a melanotic sarcoma had been removed from the limbs, and in both there had developed secondary deposits in the bladder, which could be seen with the cystoscope, without evidence of deposit in other parts. He thought the cause of the retroperitoneal hæmorrhage in the case now described could be explained. When the secondary deposit developed in the kidney it was on the outer surface, and at first it burst into the retroperitoneal tissues. The little excoriation in the capsule through which it burst then healed up, and the next burst was into the pelvis of the kidney. The growth thus found an easier line of advance into the pelvis and ureter, and it no longer pressed outwards so as to bleed into the retroperitoneal tissues.

Mr. CURTIS agreed there was a difficulty in determining the relation between the initial retroperitoneal hæmorrhage and that from the kidney growth, but he thought that to refuse to operate on the foot for fear of setting up melanoma elsewhere was a mistake. The growth which occurred in the region where the hydronephrotic kidney was removed was an indication of the path of invasion followed by the growth. The other reason for it settling in the hydronephrotic area was perhaps the lowered resistance of that part. If malignant growth was detected, the sooner it was removed the better: fear of setting up growths elsewhere should not be a deterrent.

Mr. PHILLIP TURNER (in reply) said that at the time he removed the kidney the growth was coming through the capsule; he doubted whether it did so when the hæmatoma was present. There was no evidence of any other secondary growth at the time of the operation. When the retroperitoneal hæmorrhage occurred he thought before the operation that he might find a gall-bladder condition, or possibly appendix trouble. He found the hæmatoma, and he did not do anything to the kidney, which was concealed by the hæmorrhage in front of it. He suspected some retroperitoneal growth at the time, but he could not feel one. The operation was simply an exploratory one.

Specimen from Case of Carcinoma of the Ureter, Secondary to Carcinoma of a Congenital Hydronephrotic Kidney.

By FRANK KIDD, F.R.C.S.

MALE, aged 48.

History (October 21, 1918): Five years' hæmaturia and occasional dull ache in the right kidney region. During the last year has bled a little every day. Looks very anæmic. Hæmoglobin percentage, 40; red blood corpuscles, 3,750,000. General blood-pressure 178 mm. of mercury.

Cystoscopy: Blood issuing from the right ureter, no indigo comes through in half an hour; left ureter, clear urine in good quantity; indigo comes through in ten minutes in large amount.

Abdomen: Hard nodular enlarged right kidney can be felt.

Operation (October 28, 1918): Right kidney removed, specimen not preserved. The upper end of the right ureter is blocked with a nose of papillomatous growth. The kidney is very much distended and thinned—congenital hydronephrosis. The surface of the thinned-out pelvis is covered throughout, especially in the lower pole, with multiple papillomatous growths which do not appear to invade deeply anywhere.

Microscopic sections reported on by Professor Turnbull, of the London Hospital: "Papillary, stratified, columnar-celled, mucous carcinoma of the renal pelvis."

Progress: Patient went on very well until May, 1920, when he began to pass blood again.

Cystoscopy (May 13, 1920): A papilloma can be seen peeping out of the mouth of the right ureter. The ureter is distended by the growth and its mouth prolapsed into the bladder. The rest of the bladder is quite healthy.

Second operation (May 17, 1920): Spinal anæsthesia combined with open ether. Middle line incision in the abdomen. The ureter was completely exposed, extraperitoneally, and the bladder stripped completely of its peritoneal covering. The bladder was then opened on the right side. The ureter was removed entire, including ½ in. of the wall of the bladder surrounding its opening into the bladder. The bladder was then stitched up and drainage established through the perineum and from the bladder itself.

Specimen shown: The ureter forms a specimen about 14 in. long, the wall of which is very much thinned and the lumen dilated to the size of a large penholder. It is partially blocked by a papilloma at its extreme end. There is also a small papilloma near the upper end.

Progress: The wound healed up well and the patient left the home in the middle of June, 1920, passing his water naturally. Since then he has had no further trouble and is able to do his work and play golf.

COMMENTS.

Congenital hydronephrosis is often associated with other diseases; and I have seen several cases in which stone or tumour had developed in a hydronephrosis. It is generally recognized that a predisposing cause of papilloma of the renal pelvis is stone, but I do not think it has been recognized that hydronephrosis may also be a predisposing cause.

I have seen three types of growth in the renal pelvis,' simple papilloma, malignant papilloma, and excavating ulcerating carcinoma. These growths betray the true embryonic origin of the ureter and pelvis of the kidney. The ureter and pelvis arise from the Wolffian duct, and embryologists dispute as to whether this is ectodermic or mesoblastic in origin. Growths of the renal pelvis, especially the carcinomatous growths, show a tendency to the formation of cell-nests; and in this and other respects closely resemble carcinomata arising in the female urethra, which strongly suggests that the Wolffian duct arises from the ectoderm. These cases are relatively non-malignant. This patient had shown symptoms for five years, yet even after so long a time he seemed to be free from secondary deposits in other parts of the body.

The process whereby a growth seeds itself downwards along a natural tube is well-known in the ureter and in the alimentary canal, but the process of seeding backwards against the natural stream is not so well known. The other case I had hoped to show to-night seemed to be one of primary carcinoma of the ureter where seedlings of growths had seeded backwards into the kidney, the ureter having become blocked by the primary growth. Unfortunately the specimen has been mislaid.

It is important not to forget palpation in these cases, as mistakes are often made by forgetting to carry this out. This had evidently been omitted in my patient by the two other surgeons who had previously seen him: they had stated that they could not make a diagnosis as he was not bleeding at the time they saw him, yet abdominal palpation made it clear that he had a large tumour of the right kidney.

The patient looked so anæmic that I thought it would not be safe to operate without carrying out blood transfusion; but when examined by a pathologist his hæmoglobin was 40 per cent. and the red cells 3,750,000, i.e., he was above the 30 per cent. boundary line of safety below which it is not safe to operate.

Another point worth noting is that although you may see growth hanging out of the mouth of the ureter, you cannot say you are dealing with papilloma of the renal pelvis. I have seen growth hanging out even when the case has been one of primary tumour of the kidney, i.e., the tumour has ulcerated through into the pelvis and has formed a long pedicled string of growth which has elongated until it actually sticks out of the mouth of the ureter.

With regard to prognosis, I think one should never despair in advising removal of renal tumours. One can never tell what will happen, and the patient should be given his best chance, viz., operation. If hæmaturia recurs after removing papillomata of the renal pelvis, one should inspect carefully to see if the bladder is clear, and be prepared to sacrifice the ureter. This is, I think, a real advance in renal surgery. I know of other surgeons who have done such operations with success. The question may be asked, should you remove the ureter as well at the primary operation if you find you are dealing with papillomata of the renal pelvis? In the cases of which I have had experience the patients have been too ill to justify removal of the ureter at the same time, so that I think it is advisable to wait to see what happens. If bleeding recurs after a primary nephrectomy, we should be prepared to carry out a second operation for the total extirpation of the ureter.

Mr. **THOMSON WALKER** said Mr. Kidd did not refer to primary growths of the ureter; he took it he meant growths in the pelvis of the kidney with secondary growths in the ureter. At a previous meeting, he, Mr. Thomson Walker, had brought forward three cases of primary growth of ureter, which were probably simple growths. Since then he had had a communication from Dr. Hawthorne in regard to one of them (Case 11, R.S.). A few months after ureterectomy the patient developed signs of malignant growth, namely, severe pain, vomiting and emaciation and there was an irregular mass in the right abdomen. The left lobe of the liver was enlarged and irregular. A mass could be felt in the pelvis and there were nodules in the skin. The patient died five months after the operation, and there were found multiple masses in the abdomen, including growths in the liver, and sections of the latter showed carcinomatous deposits.

Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

The Prevention of Urinary Obstruction after Prostatectomy.[1]

By J. W. THOMSON WALKER, M.B.Edin., F.R.C.S.Eng.

THIS article deals with fibrous contraction of the vesical outlet after suprapubic prostatectomy, and with an open operation for its prevention. No paper upon this subject should open without a reference to the fundamental work of our President, Sir Peter Freyer. I can look back to the time when castration, following the erroneous teaching of White, was in vogue as a cure for enlarged prostate, and when Harrison was attempting to prove by statistics that resecting the vas was an efficient substitute and would cure the condition.

I can thus appreciate more fully than many of you here the immense change that was brought about by the introduction of suprapubic prostatectomy by Sir Peter Freyer. It is therefore in no carping spirit of criticism of the operation of suprapubic prostatectomy that I bring forward those cases of post-operative obstruction, but with a view to discussing with you whether some modification of the original operation is not necessary in order to meet this sequel shown by experience to occur.

I shall first relate sixteen cases of post-prostatectomy obstruction and then discuss them.

Case 1.—R. T. H., aged 55 (Ref. No. 24). Examined January 23, 1917. Prostatectomy September 28, 1916 (general surgeon). Prostate adherent and operation difficult. Fistula persisted. On November 18 surgeon introduced forefinger into the bladder and pushed metal bougie through the closed internal meatus. January 13, 1917: Fistula still leaking, instruments passed under anæsthetic. On the 23rd urinary fistula through which all urine discharged; bougies arrested at internal meatus. February 14: Operation. Internal meatus admitted a small metal bougie and was surrounded by hard scar tissue. This was excised and a free opening into the prostatic cavity obtained. Wound healed satisfactorily and urine passed in good stream.

A year later the surgeon who had performed the original operation wrote to me about him as follows: "I saw a few days ago an old patient on whom I operated for enlarged prostate. I was pleased and surprised to see him so well, as when I last saw him there was great trouble from cicatricial contraction of the commencement of the urethra and I feared carcinoma. I congratulate you on a remarkable result."

Case 2.—H., aged 71 (Ref. No. 29). Examined March 21, 1918. Prostatectomy January 14, 1918 (general surgeon). Prostate large and shelled out in one piece. Difficulty in separation on left side and posteriorly. Emphysema, bronchitis, dilated heart, and glycosuria. Three weeks after operation attempts to pass catheter failed. February 17: Instruments passed with finger in bladder and catheter tied in for fourteen days. March 21: Urine discharged entirely by suprapubic fistula, metal instrument arrested at entrance into the bladder. Bladder opened freely, internal meatus completely closed by thick membrane. Membrane excised and large opening into prostatic cavity obtained. A month later suprapubic wound healed and urine passed naturally.

Three months after operation patient died of cardiac failure, having continued to void urine naturally.

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[1] At a meeting of the Section, held January 27, 1921.

Case 3.—P. W., aged 64 (Ref. No. 35). Examined April 15, 1918. Prostatectomy November 3, 1917 (urinary surgeon). Difficulty in enucleation at lower part of prostate. After operation increasing difficulty in passing catheters. Fistula persisted and urine passed partly by urethra. February, 1918: Surgeon opened bladder and tied catheter in urethra. Wound healed but repeatedly broke down again. There was difficult micturition and attacks of retention. A catheter was obstructed at the internal meatus. At night urine passed only by catheter. April 29, 1918: Bladder opened freely; vesico-prostatic opening was a small aperture surrounded by a thick cuff of fibrous tissue which gripped a fine catheter tightly. Fibrous tissue removed and prostatic cavity exposed. July: Wound closed, micturition normal.

Case 4.—A. W. W., aged 66 (Ref. No. 35). Examined November 4, 1918. Prostatectomy November, 1917 (general surgeon). Since operation frequent micturition day and night and intense desire and spasm. Catheter passed occasionally with difficulty 8 inches from meatus.

On rectal examination a hollow in region of prostate with some thickening on either side. On cystoscopy outline of internal meatus very irregular, a diverticulum at bladder base. November 20, 1918: Bladder opened, a pea-sized nodule of gland tissue at posterior lip of internal meatus. Internal meatus surrounded by fibrous ring; diverticulum with capacity of bean. Nodule removed and large opening into prostatic cavity obtained by cutting away fibrous ring; diverticulum excised. October, 1919: He reported "result of operation splendid and water passed very easily."

Case 5.—W. M., aged 60 (Ref. No. 38). Examined February 13, 1919. Prostate removed September, 1918 (general surgeon). Prostate large and operation straightforward. Fistula persisted and healed up for short periods. Difficult micturition, sometimes performed only in recumbent position; dribbling at end of act. Metal instruments passed regularly but with difficulty. Rectal examination showed hollow area in prostatic region and no sign of malignant infiltration. February, 1919: The surgeon again operated, but failed to reach the obstruction and could not pass an instrument through the urethra.

May: I exposed the bladder and found internal meatus surrounded by hard fibrous tissue. This was cut away and a free opening obtained; the wound healed satisfactorily, the bladder closed, and patient was able to pass water freely.

Case 6.—A. H., aged 53 (Ref. No. P. 246). Examined July 8, 1920. Prostatectomy March, 1920 (urinary surgeon). Wound healed. Two weeks after returning home difficulty of micturition recommenced, and finally no instrument could be introduced into bladder, obstruction being at internal meatus.

Operation July 12, 1920. Internal meatus surrounded by scar tissue and admitted probe. Scar tissue cut away; irregular areas of fibrous tissue in wall of prostatic cavity, and in dissecting a fibrous mass a portion of the rectal wall was excised. Edges of rectal wound brought together with catgut stitches, catheter tied in urethra and prostatic cavity packed with iodoform gauze. Continuous irrigation of bladder and prostatic cavity, and frequent rectal washing. Wounds healed, and patient left hospital passing clear acid urine freely.

Case 7.—A. F. H., aged 63 (Ref. No. 46). Examined October 11, 1920. May, 1918, prostatectomy (general surgeon with special experience). Moderately enlarged firm prostate. After operation great difficulty in passing instruments. Urethra dilated with metal instruments. Fistula persisted in spite of retained catheter. For eighteen months urine passed only in a dribble, and patient has been on catheter life. Fistula closes for some weeks and then reopens. Micturition ceases after passing an ounce of urine and then catheter withdraws about a pint. In rectum a hollow prostatic area without induration. Small catheter passed but was gripped at internal meatus.

Operation October 21, 1920. Masses of fibrous tissue removed and bladder mobilized. Neck of bladder and internal meatus drawn under arch of pubes and fixed with fibrous tissue. Mucous membrane at internal meatus fell together laterally so as to close it. With finger no opening felt. On introducing catheter the internal meatus was found to be an antero-posterior slit, surrounded by hard, fibrous tissue, which gripped the point of the catheter. Fibrous ring was dissected away and free entrance to prostatic cavity obtained. Small fistula persisted for some weeks, but eventually healed. There was a full and powerful stream and no residual urine.

Case 8.—E., aged 63 (Ref. No. 48). Examined October 27, 1920. October, 1918, prostatectomy (urinary surgeon). Enlarged prostate and some calculi removed. During convalescence difficulty in passing urine and instruments were passed. After leaving the home obstruction increased, and in March, 1919, catheter passed with difficulty. April, 1919: Complete retention. Instruments failed. A general surgeon opened bladder and introduced catheter. After that much better, but had to use catheter frequently. Difficulty of micturition increased, and in June, 1920, instruments were passed twice. Dilatation was followed by increased difficulty and retention, requiring catheter. During September and October, 1920, there were repeated attacks of retention of urine, relieved by dilatation by bougies and passage of catheter. I examined him on October 27, 1920. He was confined to bed and in a nervous, depressed condition, with tremors of hands and legs. Bladder not distended; in rectum there was a hollow prostatic area; no dilatation of seminal vesicles and no induration. Metal catheter (No. 8) passed an obstruction at the membranous urethra and another at entrance into bladder, where it was tightly gripped.

I operated on November 4, 1920. Large hernia of suprapubic scar. Lower part of bladder and internal meatus were dragged down under the pubic arch by fibrous tissue and were very difficult to reach. Internal meatus was a rigid ring admitting tip of little finger. A quarter of an inch below this the catheter lay in hard ring of fibrous tissue. Fibrous tissue at internal meatus and in prostatic cavity was dissected away. Anterior wall of prostatic cavity also dissected away from pubic symphysis.

Patient returned home five weeks after operation. Urine was then passed freely with good stream but with some lack of force. Catheter passed easily into bladder; no residual urine. At times there is an escape of a few drops of urine on rising suddenly or on sitting up in bed, but this symptom now (March, 1921) occurs at long intervals.

Case 9.—W. S., aged 55 (Ref. No. P. 387). Examined November 4, 1920. Prostatectomy June, 1920 (general practitioner). After operation never passed urine by urethra except with catheter; urinary fistula persisted, instruments being arrested at internal meatus. Prostatic area soft, no induration.

Operation November 8, 1920. Scar excised, bladder base exposed; internal meatus found to be completely closed; tongue of tissue about size and shape of bean and free at one end projected upwards from the bladder base in position of internal meatus. This mass was cut away and mucous membrane and fibrous tissue forming roof to prostatic cavity removed, and free opening made. The patient made uninterrupted recovery, and left hospital healed and passing urine freely in powerful stream.

Case 10.—A. D., aged 60. Examined January 13, 1921. Prostatectomy September 11, 1920 (general surgeon). Prostate removed with difficulty in two pieces. Very adherent posteriorly. Catheters passed during convalescence. Healed in nine weeks, but broke down again and has since healed and broken down several times. Metal instruments were passed. Urine passed with difficulty; micturition easier lying on back. Residual urine varied from six to nine ounces.

Operation January 19, 1921. Thick masses of scar tissue dissected from suprapubic area and bladder freely opened. Internal meatus admitted tip of little finger, and was filled with soft granulation tissue. About a quarter of an inch below internal meatus prostatic cavity narrowed by fibrous tissue which reduced lumen to No. 6 English bougie. Fibrous tissue was dissected away and found to extend down to triangular ligament where opening was small and rigid. Catheter was tied in; recovery was complete, with free and powerful stream.

Case 11.—R. S., aged 60 (Ref. No. 18). Examined June 15, 1914. Prostatectomy March 4, 1914 (general surgeon). Operation difficult; prostate hard and fibrous; no irrigation of bladder during convalescence. First time catheter was passed a gush of pus came away, but no urine. Many unsuccessful attempts were made to pass instruments into the bladder. Suprapubic fistula persisted, and all urine discharged through this. On examination skin of lower abdomen eczematous; suprapubic scar thick and indurated. All urine was discharged through fistula. Obstruction to instruments after passing membranous urethra, and between this and the bladder there was an area of hard fibrous tissue. Metal instruments passed up to 16/18 English and a catheter tied in urethra. In fourteen days suprapubic wound healed and eczema disappeared. Urine passed freely by urethra. Patient died suddenly four months after I saw him after obscure abdominal symptoms. Intestinal obstruction was found, due to a band extending from upper part of right side of bladder down into pelvis.

Case 12.—C. H., aged 61 (Ref. No. 16). Examined April 6, 1914. Prostatectomy (general practitioner), January, 1914. Suprapubic tube retained for fourteen days after operation. Fistula persisted, only a few drops of urine being discharged from urethra and a stream from fistula. Obstruction at vesico-prostatic junction, which admitted small instrument. On rectal examination a hollow area was found in place of prostate and no induration. Catheter tied in and suprapubic wound healed, but there was constantly recurring difficulty of micturition and instruments were passed at intervals. He lived in the country, and finally was able to pass instruments himself and keep the scar dilated.

Case 13.—S. W., aged 58 (Ref. No. 14). Examined March 17, 1914. Prostatectomy October 23, 1913 (urinary surgeon). Simple adenoma. Great difficulty in passing catheter three weeks after operation. Patient left the home November 30 healed and passing fairly good stream, which got gradually less, and at end of December was reduced to a mere dribble. Surgeon again attempted to pass catheter and failed. Patient was told that there was block at neck of bladder. When I examined him urine was passed in feeble dribbling stream. In the rectum there was a hollow area in place of prostate, but no induration. In passing instrument there was difficulty at membranous urethra and also at internal meatus, and I failed to enter bladder. Operation for removal of obstruction recommended, but I did not see patient again.

Case 14.—W. P., aged 75 (Ref. No. 34). Examined December 12, 1918. Prostate removed (urinary surgeon). Prostate large and shelled out easily. Wound closed, but in a few months he had increasing difficulty in micturition and required catheter. In March, 1916, bladder was opened and internal meatus dilated; the wound healed quickly. When I examined him he complained of frequent micturition, and passed a small dribbling stream after great difficulty. I failed to pass an instrument into the bladder, the obstruction being at the internal meatus. Fibrous thickening in prostatic area was felt from rectum.

On December 18, under spinal anæsthesia, instruments passed and a catheter tied in urethra. The obstruction slowly recurred, and on March 20, 1919, I again passed instruments.

Case 15.—W. G., aged 77 (Ref. No. 33). Examined October 5, 1918. Prostatectomy five years before (general practitioner). Prostate weighed 11¼ oz. For some months before I saw him he had increasing difficulties of micturition and frequency of straining. Prostatic area flat and no sign of malignant infiltration. I failed to pass instruments, the obstruction being at the internal meatus. Under an anæsthetic the fibrous ring was dilated and a catheter tied in. Micturition was free for a time, but on November 29, 1918, the obstruction at the internal meatus had again developed. Urethra dilated and a catheter tied in. I have lost sight of this patient.

Case 16.—R. S. R., aged 58 (Ref. No. 49). Examined December 1, 1920. Prostatectomy May, 1919 (urinary surgeon). Previous to operation was on catheter life. Operation said to be difficult, but no information in regard to prostate; wound healed in four weeks. Had bilateral epididymitis. Since operation patient can pass 1 oz. of urine voluntarily and then requires catheter. He had undergone a course of electric treatment for the bladder since the operation. On examination the bladder was distended. The prostatic area was hollow and without induration. A small catheter passed with difficulty, being gripped in prostatic area. Two pints of stinking alkaline urine were withdrawn. No sign of disease of the nervous system and no history of syphilis. I did not consider that there was nerve atony of the bladder, but regarded the condition as one of obstruction at the internal meatus. Cystoscopy recommended, but patient refused.

Discussion of Cases.

These sixteen cases are patients suffering from obstruction after suprapubic prostatectomy, the obstruction being due to the formation of fibrous tissue in the area from which the prostate was removed. The cases have been carefully selected so as to exclude two types of case in which there is post-prostatectomy obstruction, but which for the sake of clearness I am anxious to exclude from discussion at present. These types are:—

(1) Obstruction due to prostatic lobes left behind at the operation. I have seen a few cases where a large part of the prostate, amounting to a whole lobe, or even what would appear to be both lobes, was discovered in examining for the cause of the obstruction after a so-called prostatectomy. Freyer has published such cases.

(2) Obstruction due to malignant growth following the removal of a prostate. This includes cases frankly malignant at the time of the operation, cases where there was a suspicion of malignancy, and the difficulty in enucleation and eventually the microscope proved that malignant change had occurred in a simple enlargement of the prostate; and, finally, cases where clinically there was a simple enlargement, but the pathologist reported that some part of the adenomatous prostate showed malignant changes.

All these types I have excluded from this article as they raise issues outside those I wish here to discuss. Further, I wish to make it clear that there are here no cases of atony of the bladder from disease of the spinal cord, or atony of the bladder of the type I have described as atony without obstruction or signs of nervous disease. The tone of the bladder in these cases was normal and capable of projecting a good stream of urine when the obstruction was removed.

Post-operative History.

The post-operative history of these cases is of interest. In some the obstruction appeared early in the convalescence from the operation. There was a delay in passing urine, and instruments were passed usually about three weeks after the operation in order to dilate the urethra and assist the passage of urine. In other cases there was difficulty in passing a catheter from an early date after the operation, and a catheter was tied in. In spite of these precautions obstruction commenced either at once or soon after leaving the home. In one case the obstruction became evident some months after the operation and in another only four years after the operation. In two cases no urine was passed at any time after the operation, and all attempts to pass instruments into the bladder failed. These two patients were told that the condition was incurable, and the suprapubic fistula must remain open. A suprapubic fistula persisted in eight of the sixteen patients, and in four of these all the urine was passed through the fistula, no urine passing by the urethra. In the remaining four cases some urine passed by the urethra and some by the fistula. In two of these (Cases 5 and 7), the fistula healed up from time to time and then broke down again.

In cases where the wound healed completely or the fistula only broke down occasionally, the symptoms were those of severe obstruction, usually constant, but occasionally varying from difficult micturition and straining to periods of retention. In such cases the patient was on catheter life, the catheter being passed with great difficulty. In three cases after some months instruments were passed under an anæsthetic and the stricture dilated, this proceeding being repeated on several occasions. In four cases a second operation had been undertaken, the bladder being opened, instruments being passed, and a catheter tied in the urethra. In all of them the obstruction had recurred.

Anatomy of the Prostatic Bed after Prostatectomy.

In order to understand the condition present in these cases it is necessary to have a clear idea of the anatomy of the parts after prostatectomy. The enlarging prostate expands in two directions: (1) backwards towards the rectum, expanding the fascial sheath and stripping it from the bladder base; and (2) upwards into the bladder, stretching the sphincter and pushing up through it into the bladder cavity.

After enucleation of the prostate a cavity of varying size is left. Lying on the postero-inferior wall of this is a small strip of the mucous membrane of the urethra, representing the portion of the posterior wall of the prostatic urethra which lies between the verumontanum and the membranous urethra (fig. 1, *1* and *2*). The seminal vesicles lie in the posterior wall, having been stripped from the bladder base by the enlarging prostate. This cavity is roofed by a shelf or canopy formed by the bladder base, and communicates with the bladder cavity by the opening through which the prostate was enucleated. This opening varies very greatly in size.

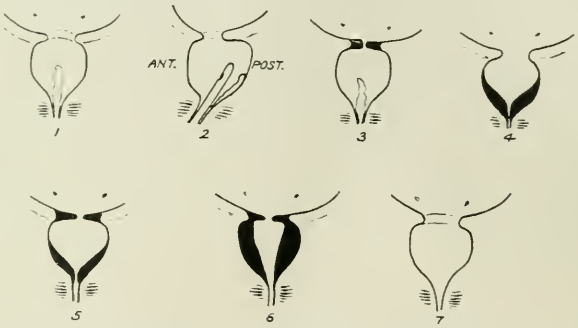

Fig. 1.—Prostatic cavity after suprapubic prostatectomy. *1*. Coronal section showing prostato-vesical opening (dotted lines), strip of prostatic urethra on posterior wall, compressor urethræ muscle; *2*, sagittal section with catheter showing posterior ledge; *3*, fibrous contraction at prostato-vesical opening; *4*, fibrous contraction at prostato-urethral outlet; *5*, fibrous contraction at both outlets; *6*, fibrous tissue in wall of cavity; *7*, prostatic cavity after removal of fibrous masses.

In prostates where the intravesical projection of the prostate has been very large, the opening may be so wide that there is scarcely any ledge at all. In the majority of prostates, however, this ledge is very pronounced, and the opening into the vesical cavity lies at the anterior part of the roof of the prostatic bed. This is most evident in the type of prostate where the enlargement has been extravesical and can be felt prominently in the rectum, but does not project through the sphincter into the bladder, and in those prostates where there is a small intravesical nodule and a large extravesical adenomatous mass. At this prostato-vesical opening the mucous membrane of the urethra, where it joins that of the bladder, is torn across.

The urethra communicates with the prostatic cavity at the lower end and anterior part, this part of the urethra being directed obliquely upwards and backwards. The mucous membrane of the urethra is usually torn across very obliquely at the prostato-urethral junction. The anterior wall is torn at or near the point where the membranous urethra joins the prostatic cavity, a strip of the posterior wall of the prostatic urethra extending as high as the verumontanum is usually left behind, adhering to the posterior wall of the prostatic bed. On examining specimens of the enucleated prostate, when the gland has been removed in a single mass, the absence of this strip of the posterior wall of the prostatic urethra will be noted. In some cases a large part of the prostatic urethra remains as a long ragged tube attached to the membranous urethra, in other cases a long tube of the mucous membrane of the membranous urethra is removed with the prostate. These conditions are, however, exceptional, and the common condition is as I have noted.

Anatomy of Post-operative Contraction.

It is many years since I showed[1] that there were two danger points for the development of stricture after prostatectomy—namely, at the membranous urethra when the mucous membrane is severed, and at the outlet of the bladder when the mucosa of the bladder neck is torn across. It is rare to find any contraction at the membranous urethra, partly because it is the custom to pass the catheter in order to wash the bladder during convalescence; if there is any obstruction here it will at once be noticed, and catheters of different calibres passed through it. But the principal reason for the absence of contraction at this point is, I believe, to be found in the strip of mucous membrane which almost always remains attached to the posterior wall of the prostatic bed. This strip prevents the formation of a circular ring of fibrous tissue, which might develop if the mucous membrane were torn across transversely.

In some cases where a sleeve of mucous membrane of the membranous urethra is removed with the prostate there is certainly a tendency to contraction of the scar in the region of the triangular ligament. In these sixteen cases there are only two where the obstruction was very pronounced at the urethral end of the prostatic cavity. It is at the inlet of the prostatic cavity into the bladder that the contraction usually takes place, and obstruction at this part was present in fourteen out of the sixteen cases here recorded (fig. 1, *3*).

In ten of the sixteen cases I operated, opening the bladder freely and inspecting the prostato-vesical opening. In four of the cases the obstruction was physiologically complete, all the urine passing through a suprapubic fistula. In the remaining twelve the obstruction was incomplete. There were two cases where the internal meatus was completely closed, no trace of an opening being discovered either by palpation or by inspection. In one of these (Case 2) the base of the bladder was smooth, and there was no indication as to where the opening into the prostatic cavity had been. In the other case (Case 9) the opening was obliterated, but just behind its probable position, judged by pushing up the roof of the prostatic cavity from below with a metal sound, a tongue-shaped nodule of prostatic tissue, the size of the terminal joint of the thumb, projected upwards and forwards. This tongue of prostatic tissue was attached by a comparatively narrow base, and had evidently been a nodule which was partly detached at the time of the operation, but had retained a sufficient blood-supply to survive. Had an opening into the prostatic cavity been present it would have acted as a valve. In the two remaining cases, where the obstruction to the passage of urine was complete and the introduction of a catheter was impossible, the internal meatus was so small that only a fine probe could be passed through it from the bladder into the prostatic cavity (Cases 1 and 6).

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[1] *Brit. Med. Journ.*, 1905, ii, p. 1250.

In two cases a fine catheter could be passed with great difficulty. In one the catheter was found at operation to be firmly gripped by a ring of fibrous tissue (Case 3). In the second (Case 8) the internal meatus was fibrous but open, and admitted the tip of the forefinger. Below this, near the apex of the prostatic cavity, there was a dense mass of fibrous tissue which caused the obstruction. This on dissection was proved to extend to the membranous urethra (fig. 1, *4*).

In three cases a No. 8 catheter could be passed after some difficulty, and at operation there was a fibrous ring which held the catheter in a firm grip (Cases 4, 5, and 7). In one of these, in addition to the fibrous ring, there was a small nodule of prostatic tissue on the posterior lip of the opening, and also a diverticulum of moderate size (Case 4). In another, on removing the catheter the fibrous sides of the ring came together and formed a narrow antero-posterior slit.

In all the cases complete restoration of the bladder function with free flow of urine followed the operation and the fistula healed.

Possible Causes for Failure of the Operation.

Before passing on to consider the treatment of these cases and the method of prevention, two points will be considered.

(1) Is the post-operative obstruction in these cases due to inexperience or lack of skill on the part of the operator?

In the cases here recorded we find that three were operated on by general practitioners, six by general surgeons, one by a general surgeon with special urinary experience, and six by urinary surgeons. I do not wish to give the impression that although the cases are practically divided between the general surgeons and the urinary surgeons, these two types of operator are specially responsible for the result, for it must be obvious to anyone that the general surgeon operates on a much greater number of cases of enlarged prostate than the general practitioner, and it is a fact that the urinary surgeon operates on more cases of enlarged prostate than the general surgeon. The true proportion could only be reached by taking the percentage of the results of all cases operated on by each class, a figure impossible to state. What I think these figures show is, however, that post-operative obstruction of this nature may, and does, occur in the hands of the most experienced class of operators on the prostate. I draw the inference from this that, although lack of skill might have been shown in one or two cases, the operation may be skillfully carried out and still, in a certain number of cases, be followed by obstruction of this special kind.

(2) The second point to which attention will, I think, be directed is the question as to whether the type of prostatic enlargement may have some influence on the result.

I have already made clear that all cases of malignant growth have been excluded from these records. There remain two types of prostatic enlargement, the extreme examples of which differ materially from each other, the small fibrous or fibro-adenomatous type and the large prostatic adenoma. Broadly speaking, the small fibrous or fibro-adenomatous type is enucleated with difficulty and leaves a small cavity, while the large adenoma shells easily and leaves a large cavity. There has been some difficulty in discovering what type of prostate was removed in these sixteen cases and in five cases I have no information. In the remaining eleven cases five were known to be small and fibrous and six were adenomatous, five being designated "large adenoma" and one "simple adenoma." I do not consider these figures are conclusive, one-third of the cases being excluded.

I have the impression, gained from some years' experience of open inspection of the prostatic cavity and internal meatus during prostatectomy, that the condition likely to produce post-operative obstruction by contraction of fibrous tissue is more frequently present in operation on the fibrous or fibro-adenomatous prostate than on the large adenomatous—that is to say, where the size of the prostato-vesical aperture is small. In the adenomatous prostate there are frequently found long loose strips of capsule or of the anterior commissure, semi-detached nodules or prostatic tissue, or loose strips of torn urethra.

I have fully discussed and illustrated these strips, flaps, and nodules elsewhere,[1] and shall refer to them again in discussing the operation. But the fact that in six of these cases the prostate was stated to be adenomatous (five being large adenomas) shows quite clearly that fibrous contraction of the bladder outlet may occur after operation on this type of prostatic enlargement, as well as after that on the fibrous prostate.

Treatment of Post-operative Obstruction.

I will first discuss the treatment of obstruction when it has actually occurred and then turn to my proposal for prevention. It is, I believe, the routine custom with most surgeons in this country to pass a catheter daily after the operation and wash the bladder, commencing with the catheter about a week after the operation and continuing until the suprapubic wound is healed. The first evidence of obstruction is difficulty in passing the catheter, and there is delay in the healing of the wound. The wound may, however, heal up either in average time or after some delay. A fistula persisted in eight out of the sixteen cases here recorded.

The difficulty of passing a catheter into the bladder after many cases of prostatectomy is, I think, pretty generally recognized; it is due to the catheter hitching under the ledge over the posterior part of the prostatic cavity formed by the bladder base, and is surmounted by using a fully curved catheter and keeping well forward, when the instrument slips easily into the bladder. The obstruction to the passage of instruments, where there is narrowing at the internal meatus, is of similar character, but either the instrument entirely fails to enter the bladder after the whole of the roof of the prostatic cavity has been searched, or it enters the bladder and is felt to be gripped in a stricture.

In most cases of this series this has been the signal for an attempt to dilate up the internal meatus by the passage of instruments, and if the attempt was successful a catheter was tied in for a time. This treatment was adopted during the early part of convalescence after operation in several of the cases here recorded. Where it failed the forefinger was passed along the still open wound and metal instruments guided through the internal meatus or forced through the almost closed aperture. This was carried out in two of these cases. In some instances this treatment was not successful, and the obstruction either progressively increased or recurred after a time. Now either a catheter was passed constantly with difficulty, or regular or recurrent dilatation was carried out, or instruments failed altogether. When the obstruction had reached this stage either the patient was abandoned to a life of misery with a suprapubic fistula or a second operation had been performed. In four cases secondary operations had been performed at intervals of from four to ten months after the operation. These secondary operations consisted of opening the bladder, forcing a metal instrument through into the bladder from the prostatic cavity, and tying in a catheter for a varying time. In all these cases the obstruction recurred after a comparatively short interval.

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[1] *Brit. Journ. Surg.*, 1920, vii. No. 28.

I saw these patients at a time varying from two months to five years after the prostate had been removed. Four of them I treated by dilatation with metal instruments under an anæsthetic, and this was repeated several times in some cases. The contraction was temporarily relieved, but in none was a permanent cure effected. One patient learned to pass a bougie himself and used the instrument regularly: the others after one or several dilatations passed out of my care.

Dilatation in these cases is, I consider, an unsatisfactory method and gives only temporary relief. The condition is a traumatic stricture, and resembles a traumatic stricture in the bulbous urethra in the difficulty in treatment by dilatation. Moreover, the passage of instruments is usually attended with much difficulty, owing to the presence of the prostatic cavity in front of the stricture. In ten cases I operated and removed the scar tissue through a suprapubic wound.

The following points are essential in carrying out the operation:—

(1) All scar tissue in the abdominal wall is removed and the bladder separated from the abdominal wall.

(2) The bladder is dissected from the posterior aspect of the pubic symphysis, and mobilized.

(3) With the patient in the Trendelenburg position the base of the bladder is freely exposed by means of retractors.

(4) In the cases where a catheter can be passed through the internal meatus, it is necessary to withdraw this before attempting to excise the fibrous ring. The ring is grasped with long forceps and cut backwards with long curved scissors. The scar tissue on each side is then dissected away so that a free opening is obtained (fig. 1, *7*). Where the internal meatus is completely closed a metal instrument should be passed along the urethra and the roof of the prostatic cavity pushed up on the point of the instrument and incised. The whole of this canopy is then dissected away. Dissection may have to be carried into the prostatic cavity, for in some cases thick ridges of fibrous tissue may be found on the wall (fig. 1, *5* and *6*). Great care must be exercised here. The rectum lies immediately beneath and is adherent. In one case, when dissecting away a mass of fibrous tissue, I excised a strip of the rectal wall. Stitches were introduced and irrigation of the prostatic cavity and rectum carefully carried out and the wound healed, the patient leaving hospital with a clean sterile urine. This case shows the danger of too free dissection inside the prostatic cavity.

Where the obstruction lies in the neighbourhood of the membranous urethra the dissection is extremely difficult owing to the fact that the scar tissue round this part drags the urethra under the arch of the pubes, and even with a perfect exposure of the bladder base and prostatic cavity it is difficult to reach this area. I have not found it necessary after the free opening up of the prostatic cavity to tie in a catheter unless it is desired to treat concurrent sepsis by constant irrigation.

An Open Operation for the Prevention of Post-prostatectomy Obstruction.

The operation consists in first enucleating the prostate and then in freely exposing the bladder base and prostato-vesical opening by means of the Trendelenburg position and special retractors. Any fold or flap that might cause obstruction is then removed. The details of the operation are as follows :—

A catheter is passed and the bladder distended with 12 or 14 oz. of fluid. A free suprapubic incision is made, the bladder is opened, and the prostate is enucleated with the gloved right forefinger. I can in most cases dispense with the finger in the rectum, but in small tough or in very large prostates the gloved forefinger is used to push up the prostate from the rectum. The prostate being free in the bladder, the left forefinger is removed from the rectum; the glove is stripped from the left hand by a nurse and replaced by a fresh glove. The prostate is then removed from the bladder by means of forceps, aided with the left forefinger.

So far, except for the matter of gloves and the avoidance in many cases of the introduction of a finger into the rectum, the operation is that practised by Freyer. Now we depart from his technique. Instead of irrigating the bladder with hot solution, a catgut stitch is passed through each lip of the bladder wound and the patient is placed in the full Trendelenburg position. A good headlamp is essential for this part of the operation.

I then introduce my bladder retractors and freely expose the base of the bladder and the prostato-vesical opening (fig. 2). A gauze plug is pushed into the prostatic cavity to control bleeding temporarily and the bladder is emptied of clot. When this is done the plug is removed, and a careful inspection of the prostatic cavity and its inlet into the bladder is made. Hæmorrhage first claims attention. In some cases, by the position of the patient and the temporary plugging the hæmorrhage is already reduced to a very small amount of venous oozing. In most cases, however, some amount of bleeding is in progress, and in some spouting arteries are seen.

The bleeding is of two kinds, arterial and venous. Arterial bleeding comes in many cases from an artery situated at the brim of the vesico-prostatic entrance on one or both sides. There is frequently a spouting vessel on each side in this position, just below the mucous membrane. Long Spencer Wells forceps are placed on these vessels. With my handled bladder needle, a catgut stitch is passed on each side through the edge of the mucous membrane of the bladder and the sphincter and tied anterior to the forceps. Care must be taken not to pass these stitch ligatures too deeply, for the prostatic plexus of veins runs horizontally in the angle just outside this on each side. These two sutures now act as tractors to pull up the neck of the prostatic cavity and keep the edges apart. Arterial bleeding from the wall of the cavity may be seen, and the Moynihan's rather heavy artery forceps with curved beak are applied and the tissue in their grasp crushed. Venous bleeding comes mostly from the anterior wall of the cavity in which lies the vertical limb of the prostatic plexus. It is difficult to see the bleeding point here, but in most cases it is not serious and may be controlled by a temporary plug. In cases where the bleeding is unusually severe plugging with iodoform gauze will efficiently control it; this is very accurately carried out with the cavity freely exposed. The point of the catheter is pulled well into the bladder, and strips of gauze packed into the prostatic cavity round this, the gauze being removed on the second day.

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Having controlled the hæmorrhage, the next point to attend to is the removal of any structure that might produce post-operative obstruction. A large variety of tags, flaps, strips, nodules, or folds are found. It is a revelation when one comes to examine the prostatic cavity after enucleation of the prostate to see the number, size, and variety of these loose masses of tissue. I have described elsewhere the following:—

(1) Strips of mucous membrane at the prostato-vesical opening (fig. 3, *2*).

(2) Nodules of prostatic tissue in the neighbourhood of the opening. These may be present even where the prostate has apparently shelled out cleanly.

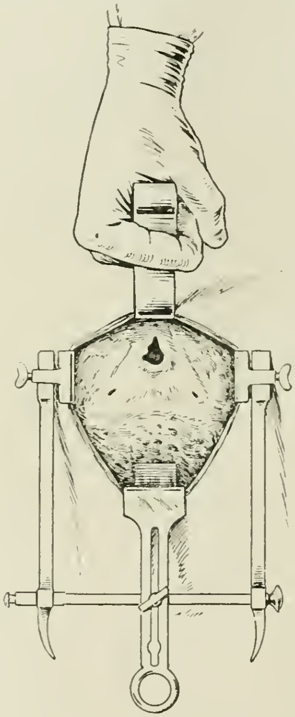

FIG. 2.—Exposure of bladder base and prostato-vesical opening after enucleation of the prostate.

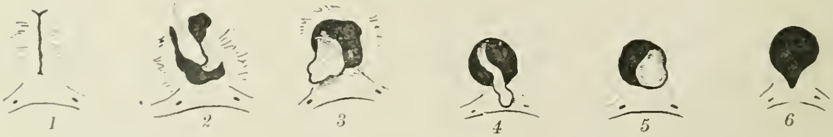

FIG. 3.—Internal meatus after prostatectomy. *1*, Lateral folds of mucous membrane closing internal meatus; *2*, flaps of mucous membrane; *3*, adherent flap of prostatic capsule; *4*, strip of prostatic urethra; *5*, adherent nodule of prostate; *6*, flaps removed and wedge of posterior fold excised.

(3) Loose strips of prostatic capsule and occasionally small nodules of gland tissue attached loosely to the wall of the prostatic cavity (fig. 3, *3*, *5*,).

(4) Loose strips of urethral wall pulled out and torn across (fig. 3, *4*).

(5) Flaps of mucous membrane. At the prostato-vesical opening there is frequently a large loose flap of mucous membrane on each side, and these flaps may almost meet over the prostatic cavity (fig. 3, *1*).

(6) A prominent semilunar ridge forms the posterior lip of the opening. This ledge is formed by the trigone and adjoins the base of the bladder.

It is to the last two structures that I wish specially to direct your attention at present, for they are the cause of the permanent obstruction. These flaps of mucous membrane may unite so as completely to close the prostato-vesical orifice and the crescentic fold is the structure that promotes the narrowing by fibrous contraction after the operation. The flaps of mucous membrane are dissected away; the posterior fold is grasped in long forceps, and a wedge with the base anterior is cut out of it with curved scissors (fig. 3, *6*). The tissue removed consists of mucous membrane, trigonal muscle, and frequently some gland tissue. This effectually obviates any possibility of narrowing at the prostato-vesical opening.

It may be objected that this free enlargement of the prostato-vesical opening destroys the vesical sphincter. In 1904 I pointed out that the action of the internal vesical sphincter was destroyed in cases of suprapubic prostatectomy from enlarged prostate. The sphincter action is taken up by the compressor urethræ, which effectually prevents the escape of urine. The prostatic cavity thus forms a prolonged neck communicating with the bladder cavity.

Having completed the clearing out of the prostatic cavity and the enlargement of the prostato-vesical opening, repair of the bladder and abdominal wall is undertaken. The retractor is removed from the bladder and the bladder blades replaced by the abdominal blades. By inserting it so as to retract the abdominal wall with the frame to the kneeward side of the operation field the anterior wall of the bladder is fully exposed. A large rubber tube is placed in the bladder and the catgut slings are crossed in front of this so that the edges of the cystotomy opening are brought together. Interrupted catgut sutures are placed in this the slings are removed, and the bladder drops down into the pelvis. A small rubber tube is placed in the prevesical space. Two catgut mattress sutures are placed through the recti and sheath about an inch on each side of the wound, and the margins of the anterior rectus sheath are united with a continuous catgut suture.

DISCUSSION.

Mr. SWINFORD EDWARDS thought that this condition must be rare as, out of several hundred cases, he had had difficulty in passing an instrument after the operation in three or four, and he had only once to reopen the bladder. He recommended a punch operation in the milder cases of obstruction.

Mr. SWIFT JOLY divided the cases of obstruction after prostatectomy into three clinical groups. In the first the prostatic cavity was either completely shut off from the bladder, or the opening between them was valvular. In these cases a suprapubic fistula always persisted. In the second, some urine was passed naturally, but there was either a partial retention or a suprapubic fistula. In the third, the patient could empty his bladder completely, but only with difficulty. Whenever a fistula persisted he considered it necessary to open the bladder and resect the scar tissue both from the abdominal wall, and the prostatic cavity. In the milder cases he had some success with the punch operation, but now restricted it to cases in which the obstruction was caused by a shelf or canopy covering over the posterior portion of the cavity left after removal of the prostate. If this cavity was filled with fibrous tissue he did not recommend the punch operation as it was impossible to remove enough of the scar tissue by this means. When performing the operation of prostatectomy he was very careful first to divide the mucous membrane of the bladder as close to the sphincter as possible, so as to minimize the formation of tags, and secondly to destroy any shelf that remained between the prostatic cavity and the bladder. He considered it essential that the opening between the bladder and the prostatic cavity left after operation should be as large as possible, and believed that this was the reason why post-operative obstruction was so rare in cases in which the prostate was really large.

Mr. J. B. MACALPINE said that Mr. Thomson Walker's method appealed to him for two reasons: first, because manipulations under guidance of the eye were always superior to those controlled by touch alone; and, secondly, on account of the control it gave over hæmorrhage. Stricture might occur either above or below the portion of the gland that had been removed. He had had one case of stricture of the upper or canopy type, and two in the lower situation. For the former type, he treated the condition much in the same way as Mr. Walker had described, but he thought that the canopy might be cut away, or incised, by means of an operating posterior urethroscope and the high frequency current. He considered that the prostatic cavity became epitheliated from three sources: (1) The torn edge of the mucosa covering the prostate; (2) the torn urethra; and (3) islands of gland tissue that had been exposed in the capsule of the gland. He thought if the removal of the tags were too free there might be a risk of stricture from failure of epithelialization, and cross union of the raw surfaces. He was always surprised that stricture at the penile end of the prostatic cavity did not occur more often. It was due to removal of too much of the distal urethra, but the point at which the urethra ruptured was largely beyond the control of the surgeon. In most cases he thought that about a quarter of an inch too much of the urethra came away with the prostate; this was easily compensated by nature. If, however, more than this amount were removed there was a distinct risk of stricture from adhesion of the raw surfaces. He considered that avulsion of the urethra was an unsurgical procedure, and thought that the urethra should be divided from within, before the enucleation of the prostate was commenced. For this purpose he had designed a prostatic urethrotome, which consisted of a long shaft which could be introduced into the prostatic urethra through the internal meatus. Near the distal end of the shaft were a pair of concealed knives, which were exposed when the instrument reached the correct level in the urethra, and the urethral wall could be cleanly divided by rotating the instrument. The correct level was estimated by a finger in the rectum. When the urethra had been divided, the prostate was enucleated in the usual way. He considered that this method rendered enucleation easier, and diminished shock and the risk of reflex suppression, as the sensitive posterior urethra was less roughly handled.

Mr. RALPH THOMPSON mentioned two cases of post-operative obstruction, which he had treated by passing metal bougies. He thought that the tags generally fell down into the prostatic cavity, and helped to cover the raw surface.

Mr. CLIFFORD MORSON thought that the development of excessive amounts of fibrous tissue was due to sepsis, and laid stress on the importance of careful after-treatment. He had used Mr. Thomson Walker's method for four months, and was very pleased with the results he obtained.

The PRESIDENT said that in his private practice he had no cases of a fistula persisting, and only three or four in which it was necessary to pass bougies. He described in detail the after-treatment of prostatic cases. If a lip or canopy was present after the gland was enucleated, he divided it with a scissors, and large tags were twisted off. He preferred a small abdominal incision, as he considered it diminished the risk of a ventral hernia forming after the operation.

Mr. THOMSON WALKER (in reply) stated that the time occupied in performing the operation which he had described was not more than about fifteen minutes longer than if the original method were followed, and he believed that the shock was diminished because the hæmorrhage was controlled. He did not consider the length of the incision any disadvantage so long as the abdominal wall was properly sutured. If obstruction were present, he thought it better to open up the bladder and cut away the scar tissue, than to attempt blind manipulations through the urethra. He thought that Mr. Macalpine's instrument would certainly localize the line of division of the urethra, but it would also divide the strip of urethral mucosa that remained adhering to the posterior wall of the prostatic cavity below the openings of the ejaculatory ducts. He considered the presence of this strip an important factor in the prevention of stricture at this site.

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Section of Urology.

President—Sir PETER FREYER, K.C.B., M.D., M.Ch.

The Treatment of some Cases of Congenital Deformities of the Lower Urinary Tract, with a Study of their Anatomy and Origin.[1]

By A. RALPH THOMPSON, Ch.M., F.R.C.S.

ARGUMENT.

(1) The history of a case of epispadias, in which control of urine was obtained by transplantation of a portion of the right rectus abdominis muscle.
(2) The anatomy of a case of epispadias.
(3) The history of a case of ectopia vesicæ.
(4) The clinical features of a second case of epispadias, with a suggestion as to its treatment.
(5) A simple conception of the anatomy and origin of ectopia vesicæ and epispadias.

(1) THE HISTORY OF A CASE OF EPISPADIAS.

THE full details of the clinical condition of the patient and the operation for its relief were published in the *Lancet*, October 16, 1920, so that a very brief account need be given here.

The patient, S. W., had had frequent operations for the attempted cure of his distressing condition, and had been an inmate, practically all his life, of public institutions. He was a big, healthy boy, aged 16, but had no control over the passage of urine and was willing that anything should be attempted which might give him control. After dissection of some normal recti abdominis muscles, and after hearing the opinions of some anatomists, I came to the conclusion that the rectus abdominis might be used for this purpose. The lower two-thirds of that part of the rectus which lies below the umbilicus is apparently supplied by the twelfth dorsal nerve, which enters the muscle at its border quite low down and splits, in the substance of the muscle, into an ascending and descending branch. The vascular supply of this part of the rectus is afforded by transverse branches of the deep epigastric artery, which come off at intervals of $\frac{1}{2}$ in. and pass inwards and outwards. The main trunk passes upwards and inwards, and is attached to the deep surface of the muscle.

I did not fear hernia following upon removal of this part of the rectus muscle, and the event justified this conclusion, as at no time after the operation had the patient the least sign of rupture. I also felt that the rectus muscle was a suitable muscle for controlling the flow of urine, as no undue movement would be noticed by other people in the patient's efforts to control his flow of urine. The orifice of the epispadias was situated upon the dorsum of the penis quite close to its attachment to the abdomen. The operation, which has been described in full, may now be briefly indicated as follows :—

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[1] At a meeting of the Section, held April 28, 1921.

June 5, 1920: An incision was made round the orifice of the epispadias and distant $\frac{1}{3}$ in. from it. The incision was deepened and so directed as to lie cylindrically and obliquely around the channel of the epispadias running from the bladder. When completed it was about 1 in. deep. An incision was then made on the anterior abdominal wall 1 in. to 2 in. from the middle line, beginning below in the right upper quadrant of the circular incision, and directed at first upwards and to the right, and then directly upwards to the level of the umbilicus, or slightly higher. The edges of the incision were deeply undermined and turned outwards. The right rectus muscle was exposed by cutting through the anterior part of the sheath in a vertical direction; it was then divided at a level of 1 in. below the umbilicus. The epigastric artery was also cut and ligatured. Very slight dissection enabled one to turn the lower portion of the rectus completely over upon itself, without exposing the twelfth dorsal nerve, and without kinking the artery. The cut end of the transplanted portion of the muscle was split longitudinally for 2 in. The two parts were placed in the circular wound, one on each side of, and around, the fistula. They were secured in position by sutures. The upper portion of the muscle was sutured to the sheath of the rectus. The edges of the sheath itself were then sutured together. The subcutaneous tissues were then joined by Lembert sutures along the whole length of both portions of the wound. Finally the edges of the skin were sutured. Thus the transplanted rectus was buried deeply. This was a great advantage, for though infection of the wound took place, it was confined to the skin and did not spread deeply.

The Result of the Operation.—Locally, the result was gratifying. In three weeks' time from the date of the operation the boy was holding his water all night, but not during the day; but later he succeeded in holding his water for periods of three hours or more during the day and passed a good stream as and when he desired. In August, 1920, he came into my service, and, generally speaking, held his water well; but occasionally passed it at night in his bed. As, however, he slept rarely less than thirteen hours, this can hardly cause surprise. Unfortunately he developed symptoms of calculus in the right kidney, for which I operated on September 10, 1920, and removed a phosphatic stone from the pelvis of a very small and atrophied kidney; and more unfortunately, he developed stones in the left kidney, for which I operated on February 1, 1921, and removed a calculus from a large, healthy-looking left kidney. He did well after the operation until the fifth day, when a sudden and profuse hæmorrhage at 7 p.m. led to his death at 10 p.m. on February 5.

I do not wish to pass lightly over the fatal termination, but I think it possible that the kidney condition had been set up before I did the operation of transplanting the rectus. I cannot imagine that the right kidney had atrophied to the extent it had done in three months.

The body of this boy was secured for dissection purposes under the Anatomy Act, and I will now enter upon the second part of the argument, namely:—

(2) The Anatomy of a Case of Epispadias.

It will be sufficient here to give the anatomical points brought out by the dissection of the body by Mr. Selby very briefly as they are shown well in the specimen I have to show.

First, the result of the operation is well shown. The transplanted rectus is firmly attached in its new position; it shows little signs of atrophy and its nervous and vascular supply are apparently intact. The penis is slightly drawn upwards compared with its position before operation. There is no sign of hernia.

Secondly, although the results of the operation are gratifying and the success of the operation is proved by dissection—the anatomical features of the case are most interesting and important, and they can be stated very briefly. The rectum and anus are normally situated and of normal appearance. The perineum is full and well developed. The testicles are fully descended into a normal scrotum.

The following very important fact, which is brought out by Mr. Selby's dissection, is not generally recognized, namely, that all the muscles of the perineum are present and well developed, and with a normal nerve and vascular supply. The compressor urethræ is well developed, but is not pierced by the urethra. Abutting against this muscle above is the bladder or probably the prostatic urethra. The bladder is fairly capacious. Into the prostatic urethra the vas opens on each side ; it is of normal thickness and appearance, and its lumen is patent and admits a bristle which can be passed along it. There are well marked bilateral "vesiculæ seminales." The pubes are separated from each other by a distance of 1¼ in. ; the space between them is occupied by bladder and penis, with the channel leading from the bladder to the orifice of the epispadias. The penis has well-marked corpora cavernosa with a crus and erector penis and an ejaculator urinæ.

As regards the muscle of the anterior abdominal wall I need only mention that the recti are present on each side, but are somewhat separated below, owing to their attachment to the pubes being shifted outwards with those bones. The appearance of the left rectus is normal. It may be stated finally, in this connexion, that all the pelvic and perineal normal structures are present except the greater part of the normal urethra. With the exception of the prostatic urethra there is no evidence of the presence of this structure.

This brief description will demonstrate that the condition of affairs in this specimen is very different from that usually described, especially as regards the perineal muscles, the presence of which may be regarded as one of fundamental importance.

(3) THE HISTORY OF A CASE OF ECTOPIA VESICÆ.

We now pass on to consider the third paragraph of the argument, and I will relate the description of such a case in a girl, aged 5.

The operation for formation of the bladder was described fully in the same number of the *Lancet* (October 16, 1920) as that of the previous case.

It is sufficient to state that the suture of the bladder was satisfactory, but that no control was permitted to the passage of urine. I thought that perhaps a transplantation of the rectus might be performed on this patient. It will be readily understood that she really had a condition of epispadias present after the operation of suture of the bladder. Mr. Ogier Ward most kindly helped me with the operation, for whose help I cannot be too grateful. Practically the same operation was performed as on S. W. I was much pleased with the thick wall of the bladder which had been made in front, and which gave plenty of room for the reception of the transplanted rectus. Owing, however, to the thinness of the parts below, I was compelled to include the vaginal orifice with the orifice of the urethra, and both were eventually surrounded by the transplanted portion of rectus. After the operation there was some sepsis in the wound, but it did not spread deeply. The girl has, so far, not got control, but I am having the transplanted muscle stimulated electrically, and I hope she may yet obtain it. I only brought down the outer two-thirds of the lower portion of the muscle; a mistake was made in this respect, the whole of the lower portion should have been brought down.[1]

The fourth heading of my argument is:—

(4) THE CLINICAL FEATURES OF A CASE OF EPISPADIAS WITH A SUGGESTION AS TO ITS TREATMENT.

This case was kindly sent on to me by Mr. C. R. Nitch. The patient was operated upon before when a child, and he now uses a urinal, with which he is quite pleased. The following are details of the case:—

He is a strong looking youth, aged 19. He has an orifice situated on the dorsum of the penis close to its attachment to the abdominal wall, through which urine is being constantly discharged. His pubes are widely separated from each other but the rectus produces the usual well known superficial features much the same on each side and is therefore present. He has the power of erection of the penis, and is "keeping company" with a girl. His testicles are fully descended into a normal scrotum. As he is busy during the summer he has for the present decided not to have anything done in the way of an operation, as he finds that the urinal with which he is fitted is quite satisfactory. If, however, we take into account the possibility of penile erection would it not be justifiable for the surgeon to attempt to expose the compressor urethræ and bring a funnel-shaped process of bladder through it? No harm could be done by this attempt to use the normal compressor; if it failed perhaps even in his case the rectus could be transplanted.

I now leave the clinical features of these cases to explain

(5) THE ANATOMY AND ORIGIN OF ECTOPIA VESICÆ AND EPISPADIAS,

in such a way as to lead to a simple conception of such conditions as are seen and treated by surgeons and are, therefore, compatible with life.

First, as regards epispadias, I venture to suggest that the groove present on the dorsum of the penis is not the urethra at all. The term "epispadias," although strictly correct, is very misleading as the condition is not in the least comparable to hypospadias.

If in a case of epispadias there is no urethra it is quite unnecessary for authorities to state that there is no roof to the urethra—such a statement is most misleading. Secondly, as regards the condition known as ectopia vesicæ I would suggest that the statement that there is no anterior wall to the bladder is quite incorrect, and to ask authorities not to use the term "trigone" unless they refer to that portion of the normal bladder which is known as the trigone. At birth at any rate there is a great deal more than the trigone present, and though when the infant assumes the erect posture the bladder is much diminished in size, this is due to the action of the recti, which, as is well known, much diminishes the chance of a hernia occurring in this region after an abdominal operation, and tends actually to reduce one which forms.

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[1] July, 1921: The patient is now, undoubtedly, holding her water better than she did before the operation. A curious point is that she holds her water at night even better than during the day. At night the rectus might be supposed to be less under control than during the day. I am indebted to the Sister in the Light Department at Guy's Hospital, and to Miss Turton, for the good result.

Now I would ask you to think of these conditions as fistulæ and would suggest a classification of these congenital deformities as follows:—

Congenital Fistula of the Bladder.

(1) Complete	Ectopia vesicæ.
(2) Incomplete	(*a*) Urachal fistula. (*b*) Penile fistula (epispadias).

I believe myself that the crux of the whole situation and the proper conception of these conditions is to be found in a case of ectopia vesicæ; when the surgeon reduces the everted and herniated bladder as it is seen in a young infant, the fistulous nature of the condition is at once apparent under these circumstances. Doubtless the same abdominal pressure which produces the hernia is responsible for the continued development of the muscle wall of the bladder in place of the urine in a normal bladder and as such should be regarded as very useful—but its result, i.e., the protrusion of the bladder wall upon the surface of the abdomen, is most alarming in appearance and has led, not unnaturally, to most alarming theories. The pubes are prevented from joining each other by the same cause and by the intervention of the bladder, and in fact there is a cleft of the bladder and abdominal walls, through which the bladder wall is herniated and everted. In a young specimen of ectopia vesicæ examined by me the bladder muscle appeared to be normal in extent except that it did not naturally join across the middle line in front.

The condition, then, is one of fistula; and I would venture to assert that the views of the older anatomists are more correct than those of more recent ones. As to its origin. Before proceeding to this matter I would suggest that anatomists or embryologists are hardly fair to themselves when they take compound monstrosities which happen to have an ectopia vesicæ but also incidentally an imperforate anus and a meningocele. In these fistulæ of the bladder which are not associated with the presence of any other deformity and which are quite compatible with life, I believe that the deformities under consideration are more correctly enunciated by the older anatomists than by some of the more recent ones.

You will remember that the older anatomists laid stress on some lesion of the allantois being responsible for ectopia vesicæ. More recent anatomists have laid stress upon the cloaca being at fault and some have brought into account the primitive streak. The great objection against either one, or the other, of the latter suggestions is the absence of lesions in these simple cases other than the bladder lesions; a fact which to my mind completely precludes a primitive streak or purely cloacal origin as described by some. I refer now to a beautiful drawing of Professor Peter Thompson's of a reconstructed human embryo ("Studies in Anatomy from the Anatomical Department of the University of Birmingham, 1915") in which a structure marked by him as the allantois is found passing into the umbilical cord and therefore outside the body of the embryo. Now I believe I am correct in stating that most writers on human embryology would agree that the urachus is formed from allantois, though, of course, I do not contend that they are not right when they say that the cloaca in part forms the bladder. Does the deformity come from in front or behind? In my opinion in the light of the careful dissection of S. W., in whom not only is there a normal rectum but also completely normal genital apparatus including a prostatic urethra, we can no longer accept the primitive streak theory even though this structure may extend forward towards the umbilicus, or a simple cloacal theory, because in fact the deformity is due to a lesion of the allantois occurring at a different time of early embryonic life and comes from the front. If more of the allantois, relatively according to age or absolutely, is involved then we have a complete fistula of the bladder, or when less of the allantois is involved then we have an incomplete fistula, such as urachal fistula, and, although I have no proofs of it except the important one of the failure to meet on the part of the pubes in both ectopia vesicæ and epispadias, I would suggest that in epispadias there is a complete fistula to commence with which eventually becomes in part healed, leaving an epispadias or penile fistula. S. W. certainly showed much natural scar tissue over the lower part of the abdomen.

If we admit, as I think on common-sense grounds we must do, that a urachal fistula is due to some fault involving the allantois, then surely similar fistulæ occurring near this portion, viz., ectopia vesicæ and epispadias, should also be regarded as having an origin in a fault of the allantois or allantois cloaca.

SUMMARY OF PAPER.

(1) The formation of a sphincter in a case of epispadias has been proved to be possible, apart from the indirect use of the anal sphincter by transplantation of the ureters or bladder.

(2) By reference to the dissection of S. W., the localization of the deformity to the bladder region, and the presence of the genital rectal apparatus, suggest that the cause of these visible congenital lesions of the bladder are due to a congenital deformity starting in the front in the allantois or allantois cloaca.

(3) The lesions of urachal fistula, ectopia vesicæ, and epispadias should be correlated.

(4) In ectopia vesicæ there is a complete median fistula of the bladder—in urachal fistula and epispadias the vesical fistulæ are incomplete.

(5) I do not mean to deny that lesions of the cloaca or primitive streak may not be the cause of fistula of the bladder combined with other deformities, but I very much doubt if there is any need to invoke these structures in order that comparatively simple lesions which are associated with no other deformity may be explained.

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War Section.

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C.B., C.V.O., R.N.

The Medical Requirements for Air Navigation.[1]

By MARTIN FLACK, C.B.E., M.B., B.Ch.Oxon.

(Wing Commander, Royal Air Force Medical Service.)

THE title of this paper is that employed by the International Convention of the Peace Conference. It applies to the medical requirements of the pilot as well as to those of the aerial "navigator"; indeed the paper deals more particularly with the pilot, since in the Royal Air Force the duties of both navigator and pilot will in future be carried out by those who have obtained their "wings."

Before the war, doubt was expressed as to whether special medical examination was required for those who were about to engage in flying, but after the outbreak of war the reports of medical officers in charge of flying personnel showed conclusively that such examination was necessary to exclude unsatisfactory material from the Flying Services. In the Royal Navy, Fleet Surgeon Hardy V. Wells, C.B.E. (now Wing Commander R.A.F.M.S.) had since 1912 been interested in the medical aspects of flying, and he is a pioneer of the subject in this country. Mr. Graeme Anderson, while serving with the Royal Naval Air Service, also specially studied this subject, being particularly interested in the psychological and surgical aspects. For the suitable selection of flying personnel the War Office appointed in 1916 a special Medical Board, on which Mr. Arthur Cheatle, C.B.E., and Dr. G. A. Sutherland, C.B.E., served. We owe much to the knowledge derived from their work with this Board. Dr. C. B. Heald, C.B.E. (now medical adviser to the Controller-General of Civil Aviation) also became identified with the activities of this Board. He had had previous experience with squadrons of the Royal Flying

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[1] At a meeting of the Section, held October 11, 1920.

Corps in the Field, and it was largely owing to his zeal that the Air Board established an Air Board Medical Research Committee to study the particular medical problems of flying. In this way the National Medical Research Committee, now the Medical Research Council, became interested in the subject and provided facilities for the proper investigation of the various problems, establishing also, under the chairmanship of Dr. Henry Head, the Air Medical Investigation Committee, to co-ordinate the various researches. The report of this Committee (Medical Research Council, Special Report Series, No. 53) on the Medical Problems of Flying has been recently published.

Dr. J. L. Birley, C.B.E., who acted as Senior Medical Officer for the Royal Flying Corps in the Field, has greatly advanced our knowledge of medical aspects of aviation, and has recently admirably set forth his views in the Goulstonian Lectures to the Royal College of Physicians. We owe much also to the work in this country of Dr. A. P. Bowdler, O.B.E., who for many months was in charge of the Aviations Commissions Board, and did good work in the selection of flying personnel.

The flying officer is selected both by the clinician and the physiologist. The physiological aspect is generally the subject of this paper. Much research is being carried out in regard to the stability and performance of the aeroplane, but the fact remains that for many years to come the man stepping into the machine provides the controlling and co-ordinating mechanism. As with the machine, this controlling mechanism must be in every way suitable and in the best of order; it is for this reason that only fit healthy human machines must be placed in charge of flying machines. Both for the efficiency of the Royal Air Force and for the success of civilian aviation, it is necessary, therefore, that the greatest care be exercised in the selection of the flying personnel.

THE IMPORTANCE OF PREVIOUS MEDICAL AND FAMILY HISTORY.

In choosing an aeroplane or motor car one goes into the record of the firm building it, so in choosing the human mechanism should we require a good family and personal history. The importance of this aspect cannot be overstated. For this reason careful inquiry is made in regard to previous health, especially in respect of such ailments as may influence efficient work in the air. From the surgical point of view certain conditions preclude admission for flying. Full details in regard to requirements as regards personal and family history are given in the Official Publications (F.S. 130 and C.A. Publication 1).

THE ASSESSMENT OF MENTAL APTITUDE.

In the selection of the flying officer three points have to be borne in mind:—

(1) The suitability to acquire the art of flight (the possession of a correct degree of neuro-muscular co-ordination).

(2) Capacity for high flights or flights of long duration (physical endurance).

(3) Mental aptitude for flying and in the case of the R.A.F. for combatant service in the air.

In regard to mental aptitude, in certain countries great attention is paid to the selection of the flier from the psychological standpoint. The value, for instance, of the examination of psychomotor responses is acknowledged, but in this sport-loving country it is felt that a history of aptitude for sports of various kinds is of equal value to a very special and elaborate experiment, often carried out under nerve-trying conditions during a long medical examination of the candidate. It is by no means certain also that the responses given indicate with great exactitude a man's capacity for flying, since during the process of learning to fly, the psychomotor reflexes of the individual may be greatly quickened.

Flying is largely a matter of correct hand and foot co-ordination, therefore the British authorities in assessing quickness of eye and hand and leg co-ordination attach much importance to the sporting prowess of the individual. As regards the psychological examination of the candidate, Dr. W. H. R. Rivers and Squadron-Leader Rippon, working in conjunction with an experienced pilot (the late Lieutenant Manuel), came to the conclusion that the experienced executive flying officer could here be of the greatest service to the trained psychologist. For this reason it has been suggested that at the Commissions Board of the Royal Air Force an experienced flying officer should attend to aid in the assessment of the mental aptitude of the subject for flying.

THE "SENSORY" REQUISITES FOR FLYING.

Considerable discussion has taken place as to what "senses" are particularly necessary in the flier. Since flying takes man into a third dimension of space much importance has been attached by some authorities to a "sense of balance." It is common experience, however, that when flying in a fog the aviator loses all sense of his position in regard to the earth and may find himself upside down without knowing it. Successful flying in fog will depend upon the use of special instruments. The flier relies particularly upon the sense of vision; he derives also much information from the "feel" of the joy-stick and the rudder, his contact with the seat, the sensation of the wind on his face, the singing of the wind in the wires and so forth. It is always to be remembered that with centralized controls most modern machines have a fair degree of inherent stability. They are not, however, endowed with a sense of vision or touch, hence the importance of vision and "tactile and muscle sense" to the aviator.

THE IMPORTANCE OF VESTIBULAR TESTS.

In certain allied countries, however, particularly in the United States of America, great importance was at first attached to the supposed "motion-sensing functions" of the vestibular apparatus. The success or failure of candidates for flying was believed largely to depend on them. The sensibility of the vestibular apparatus was tested by means of "rotation tests" namely:—

(1) The duration and extent of nystagmus after rotation to right or left, eyes closed, ten times in twenty seconds.

(2) The amount of "past pointing" after rotating ten times in ten seconds.

(3) The severity of the "falling error" after rotation five times in ten seconds.

So great an importance was not assigned to these tests in this country, more reliance being placed upon the results of the tests for neuro-muscular co-ordination. When rotation tests were employed it was considered that more reliable information was obtained from the ability of a candidate to perform a definite action immediately after rotation, while the subject was still suffering from the vertigo consequent thereon. Generally speaking, rotation tests, therefore, were only employed when a candidate gave a previous history suggestive of hyper-excitability of the labyrinthine apparatus (train or swing sickness).

As the results of the examination by rotation tests in France of first grade pilots flying at the Front, Major Sydney Scott, R.A.M.C. (Medical Research Council, Special Report Series, No. 37), reported that the "reactions to rotation may be excessive in some individuals and suppressed in others, but in neither case do the reactions of the semicircular canals seem to indicate an airman's probable flying ability." On the other hand Major Scott's observations showed conclusively the importance of efficient Eustachian tubes to enable an airman correctly to regulate and equalize the continuous changes of atmospheric pressure experienced during flights from low to high and from high to low altitudes. In addition to deafness and distress, vertigo, vomiting and forced movements, which interfere with the proper control of the aeroplane, are sometimes induced by the unequal pressure in the ears resulting from unilateral obstruction of the Eustachian tubes.

At the admission of candidates, therefore, much importance is attached to the free ventilation and drainage of both Eustachian tubes, as well as a healthy condition of the upper respiratory passages generally.

Squadron-Leader D. Ranken, R.A.F.M.S., has investigated the value of the rotation tests by the examination of civilian pilots. He found that experienced pilots had a tendency to reactions below what are considered normal. Disturbance, present or past, of some other system of the body, as for example by influenza and malaria, may effect the labyrinthine reactions. He concluded that "where deafness is present no examination of a candidate or pilot is complete without a careful investigation of the functions and reactions of the semicircular canals of both sides. In the absence of a discovery of present or past signs and symptoms pointing to an aural affection, routine examination by means of Bárány tests is superfluous, provided that the standard of the present examination schedule is maintained."

While acting as neurologist to the Central R.A.F. Hospital during the War, Dr. Henry Head, F.R.S. (Medical Research Council, Special Report Series, No. 53), made investigations, using the rotation chair, not as a method of measuring the response of the semicircular canals, but as a means of inducing an abnormal reaction. He was anxious to determine, not the afferent results of such stimuli, but the way in which the patient could adapt himself to somewhat violent sensory impressions. The object was to examine his control in face of disturbances of equilibrium.

A healthy man responds in a certain way to rotation, although the degree of giddiness varies greatly. He found that in certain persons who suffer from morbid phenomena in the air, the reaction is abnormal and excessive. It was frequently found possible, by rotation, to induce physiological states and sensations analogous to those experienced in the air, the disability being reproduced in a minor form. This was true, not only in cases of "giddiness" but also in those where the pilot had "fainted" in the air.

Dr. Head pointed out that complete adaptation to disturbances of equilibrium in the air is associated with automatic control of the afferent and efferent activities of lower levels of the central nervous system. A perfect pilot desires that his machine shall behave in a certain manner, and the evolution occurs. This acquired faculty can be disturbed by any condition which leads to diminished control. The aviator may lose his capacity to fly in consequence of conditions varying so widely as a gastro-intestinal attack or domestic anxiety. Exhaustion, insomnia, the distress of war flying, anxiety or fear, can all lead to defective afferent and efferent control. Efficient automatic response is no longer possible, and the pilot begins to fly badly and to make bad landings. This loss of control over the activity of lower levels may be manifested not only in bad management of the machine, but in some dangerous reaction such as "giddiness" or "fainting" in the air. When this abnormal reaction assumed the form of giddiness and nausea, it was found in most of the ten cases examined that the patient had suffered from some discomfort when he first went into the air. Inquiry usually revealed that he was unable to swing with pleasure as a child, and that he tended to be sick when travelling by train. On the other hand, all the five pilots who came under Dr. Head's care for "fainting" enjoyed their first flight and could swing with pleasure.

VISUAL ACUITY AND OCULAR MUSCLE BALANCE.

In acquiring the mechanics of flight, good visual acuity is of great importance. It is generally held that such acuity should be normal as tested by Snellen's type. During the war, however, the standard of visual acuity was reduced owing to the needs of the service, but since the Armistice it has again been raised to normal. With the object of ascertaining the importance of visual acuity in the flying officer, Wing-Commander Bowdler analysed the records of the Aviation Candidates Medical Board. The total number of records examined was divided into five groups according to the stages reached by the individuals in their flying careers, and the frequency of occurrence and degree of defects in the various groups ascertained for comparison. No individual with worse vision than $\frac{6}{12}$, $\frac{6}{18}$, was included.

Group I.—Three thousand candidates examined and accepted for training as pilots.

Group II.—One hundred and twenty-three pupils training as pilots who failed to qualify—failure occurring during instruction in flying.

Group III.—Six hundred and thirty-three pupils who were successful in gaining their wings.

Group IV.—Two hundred pilots who have been awarded the Distinguished Flying Cross, and in some cases the Bar. Though the average number of hours flown by this group is not known, it is probably considerable, but less than that of Group V.

Group V.—Three hundred and sixty-three pilots who have been medically examined by the Board when applying for a Civilian Flying Licence. This group consists almost entirely of experienced pilots with an average of 800 hours flying per man. It includes no fewer than 110 pilots, each with 1,000 or more hours to his credit, many of whom were flying before the outbreak of war. Not included in this group, were twenty pilots, examined for licence (average hours flying, 1,000), who were found to possess worse defects than $\frac{6}{12}$, $\frac{6}{18}$.

In considering the percentages under the various grades of defect within the standard allowed, it was thought advisable in view of the small numbers with the higher defects, to group the defectives in two classes for purposes of comparison:—

(1) Those with small defects, i.e.:—

$$\begin{array}{cccc} \frac{6}{6} & \frac{6}{6} & \frac{6}{6} & \frac{6}{9} \\ \frac{6}{9} & \frac{6}{12} & \frac{6}{18} & \frac{6}{9} \end{array}$$

(2) Those with comparatively large defects, i.e.:—

$$\begin{array}{cccc} \frac{6}{9} & \frac{6}{9} & \frac{6}{12} & \frac{6}{12} \\ \frac{6}{12} & \frac{6}{18} & \frac{6}{12} & \frac{6}{18} \end{array}$$

Those with normal vision in the better eye are placed among the class of small defects, as vision with both eyes together would be equivalent to $\frac{6}{6}$.

The number of defectives in the various groups classed in this way are shown as percentages of the totals examined in Table I.

TABLE I.

	Number	Visual defects Per cent.	Small defects Per cent.	Large defects Per cent.
Group I.—Accepted candidates ...	3,000	24·5	19·2	5·2
Group II.—Pilot pupils failing ...	123	18·7	13·6	4·8
Group III.—Pilot pupils qualifying...	633	18·6	12·78	5·58
Group IV.—Pilots with distinctions	200	20·5	18·5	2·0
Group V.—Civilian pilots	363	20·1	17·7	2·16

From the above Table it will be seen that:—

(1) Among the successes and failures of the pilot pupil groups,

there is little or no variation in the frequency of defects of visual acuity within the limits laid down.

(2) Comparing, however, the groups of pilots of long experience and distinction with the accepted candidates there is a diminution of 4 per cent. in the frequency of visual defects among the former; three-quarters of the diminution occurring among those with comparatively large and one-quarter among those with comparatively small defects. This suggests some falling out from flying on account of deficient vision of men with the comparatively large defects.

(3) Of 383 experienced airmen, there failed to reach the standard of normal vision in each eye, ninety-three pilots who in the aggregate had flown for 75,000 hours. Of these sixty-five had small and seven large defects with the standard, while twenty had defects ranging from $\frac{6}{12}$, $\frac{6}{18}$, to as high as $\frac{6}{60}$ in each eye.

On the whole, therefore, for military service, the available evidence is in favour of normal vision in pilots; small defects only being admissible if prolonged, efficient and distinguished service is to be rendered by the candidate.

Besides good visual acuity, it was found as the result of investigations of Major (now Wing-Commander) E. C. Clements, O.B.E., that good ocular muscle balance with good visual fusion was particularly necessary if the subject were to learn to land his machine properly. Experience has shown that, from one cause or another, ocular muscle defects may also appear after admission, either in cadets during training, or in officers after considerable periods of service, these defects creating difficulty and even inability to estimate the distance the subject is above the ground, causing "flattening out" too soon or too late, and consequent bad landings.

The exact condition in cases of heterophoria can only be worked out by the ophthalmic surgeon. Major Clements found that many of the defects shown by those tests were amenable to treatment by suitable eye exercises with Worth's amblyoscope and Wells's charts. During the period August, 1917, to July, 1918, he saw and treated 104 officers who would have been "turned down" for bad landings if they had not been sent to him for treatment. Of these cases, seventy-three could be traced officially. Of these seventy-three, fifty-five subsequently proved successful in flying, often on active service; four proved failures, primarily on account of their inability still to land a machine after treatment; six were found unsuitable for flying, but no details were obtainable as to their landings; while eight were found unfit by

Medical Boards for various reasons (for example, neurasthenia, heart trouble), apart from or in addition to their eye trouble. If the six found unsuitable for flying be added to the four definite failures, the figures give 84·5 per cent. successes after appropriate treatment. The opinion expressed as to the improvement or otherwise in the ability of these cases to land is of particular value, since the pupils in almost all cases were returned to the aerodrome from which they came for treatment, and in many cases to the same instructor.

The sample excerpt of cases given in Table II shows that after returning from treatment, many pilots were eventually posted overseas, some becoming engaged in the difficult work of deck flying. Dates are given to indicate the length of time improvement may last.

TABLE II.

Name	Date treatment finished	Type of machine	Result
H. T. R.	Nov. 10, 1917	Seaplanes	Calshot, May 13, 1918
H. M. O'L.	Nov. 12, 1917	Seaplanes	Effective; landings good (October 15, 1918)
H. M.	Dec. 16, 1917	Bombers	Posted missing May 19, 1918
J. O. W.	Jan. 4, 1918	Bombers	H.M.S. *Argus*, October 19, 1918
C. H. L. S.	Jan. 13, 1918	Bombers	Effective; landings D.H.6 good; 244 Sqdn., October 15, 1918
S. D. ...	Jan. 20, 1918	Deck flying	Effective; landings good; slight trouble with his eyes has quite disappeared (October 21, 1918)
H. R.	Feb. 5, 1918	Bombers	Effective; after carrying out five raids, Lieutenant R. went to hospital for treatment for his eyesight on June 1, 1918 (conjunctivitis); he returned on July 29, 1918, and has since carried out seventeen raids without any further trouble in his landings (November 14, 1918)
J. W. K.	Feb. 22, 1918	Bombers	Posted No. 5 Group September 9, 1918
C. W. S.	Feb. 10, 1918	Bombers	217 Sqdn., November 1, 1918
F. C. L.	Feb. 16, 1918	Bombers	Dunkirk, April 8, 1918
G. F. S.	Mar. 20, 1918	—	H.Q. 68 Wing for 256 Sqdn., October 8, 1918
E. G. W.	Mar. 16, 1918	—	H.M.S. *Furious*, June 22, 1918

TESTS FOR NEURO-MUSCULAR CO-ORDINATION AND NERVOUS STABILITY.

The tests usually applied to determine the neuro-muscular co-ordination and nervous stability of the subject are :—

(*a*) Self-balancing, the ability of the candidate to stand successively for fifteen seconds on each foot—toe pointing to the front, with the other knee bent, legs not touching, eyes closed and hands to sides.

(*b*) The power to lift at arm's length a light metal rod placed on a board from the table to the level of the shoulder and replace it without upsetting the rod (for details see Air Ministry Publication C.A. 1).

(*c*) Tremor of eyes, tongue and hands.

(*d*) Knee-jerks.

Wing-Commander A. P. Bowdler, O.B.E., analysed the records of a series of candidates, especially from the point of view of the association of signs of neuro-muscular instability with failure to train as pilot. With the exception of the records of Group II, which represents pilots and pupils examined at aerodromes by Wing-Commander Bowdler and myself, the observations were obtained either from the original medical examination sheet or from medical reports made subsequently at the Invaliding Board. A pupil has been considered successful if he has completed his training and obtained his wings; an unsuccessful pilot for the purpose of this report is one who has been declared by the Invaliding Board permanently unfit for air work, or who has crashed fatally.

The cases the records of which have been investigated and compared are included in four groups.

Group I.—One thousand accepted candidates who ultimately became successful pilots. Records taken from original medical examination form, on admission.

Group II.—Ninety-three successful pilots and pupils. Of these seventy-six had qualified and had considerable flying experience, and seventeen were successful pupils about to obtain their wings. Records taken on aerodromes.

Group III.—Two hundred accepted candidates who eventually failed to qualify, or crashed during training with fatal results. Records taken on admission.

Group IV.—Forty pupils under instruction who failed in their training, and were declared permanently unfit by the Invaliding Board. Crashes are not included in this group. Records taken by the Invaliding Board.

The results of this analysis are shown in Table III (p. 11).

It is shown by this Table:—

(1) That the percentage of cases which gave a bad reaction to the tests are very much greater among the failures—prospective or actual—than among the successes.

(2) That these signs of instability are more obvious in men who have actually flown, whether they have graduated successfully or have failed, and that therefore they may be regarded as signs of the result of "stress." The results in Group II are worse than in Group I, and similarly those in Group IV are much worse than those in Group III.

(3) A comparison of the percentages presenting the various signs or combinations of signs in Groups I and III would appear to show that poor equilibration or marked tremor seriously diminishes a candidate's chances of gaining his wings. Indeed, probably "fair" equilibration and a moderate degree of tremor are indicative of likely failure to qualify as pilot. Exaggerated reflexes, on the other hand, appear to be unassociated with any abnormal tendency to failure. Combinations of pronounced signs are so rarely observed among candidates who are accepted that the number of cases presenting them in the first three groups is extremely small. Figures available, however, show the inadvisability of accepting candidates exhibiting these signs in combination. The figures in Group IV also support this view, as they show the condition as regards these points of forty unsuccessful pupils on their appearance before the Invaliding Board after failure had occurred.

TABLE III.

	Group I 1,000 successes: Records on admission Per cent.	*Group II* 93 successes: Records after training Per cent.	*Group III* 200 failures: Records on admission Per cent.	*Group IV* 40 failures: Records Invaliding Board Per cent.
Poor equilibration alone ...	1·6	5·3	8·0	5·0
Marked tremor alone ...	2·0	6·4	5·0	20·0
Exaggerated reflexes alone	3·9	2·1	2·4	2·5
Combination of two of the signs above mentioned	0·5	0·0	3·0	40·0
Combination of three of the signs above mentioned	0·1	0·0	1·0	17·5
Total percentage presenting signs	8·1	13·8	19·4	85·0

Exaggerated reflexes and pronounced tremor occurred in 22·5 per cent. of these cases, exaggerated reflexes and poor equilibration in 2·5 per cent., pronounced tremor and poor equilibration in 15 per cent. and all three signs in 17·5 per cent.

As regards the neuro-muscular system, therefore, it may be concluded that:—

(*a*) Exaggerated reflexes alone appear to have no prognostic value, and their presence may be disregarded.

(*b*) Marked tremor and poor equilibration may be taken as signs of poor neuro-muscular stability. The case of a candidate who shows one of these signs only should receive very careful consideration. It is justifiable to assume that his chances of making a successful pilot are much less than normal.

(*c*) A candidate who shows both marked tremor and poor equilibration is probably unfitted for air work and should be rejected forthwith, unless his condition can be ascribed to some temporary indisposition. The chances are not in favour of his being able to train successfully and even if this were accomplished, his career as a useful pilot would probably be very short. Under such circumstances the expense to the country, the danger to life involved, and the waste of time to instructors are considerations that render the acceptance of such a candidate unjustifiable.

THE IMPORTANCE OF EFFICIENT CIRCULATION AND RESPIRATION.

For flying it is particularly important that the "bellows" and "pump" of the human machine shall be working efficiently. As regards the circulation the examination of the successful flying officer has shown that he is possessed of a pulse which gives the impression of a smooth, beautifully working piece of mechanism.

The chief tests applied for testing circulatory efficiency are:—

(1) The comparison of the pulse-rate sitting, at rest, standing, and after graduated exercise, raising the body-weight on to a chair five times in fifteen seconds.

(2) The measurement of the systolic and diastolic pressures.

In conjunction with Wing-Commander Bowdler, O.B.E., I ascertained the value of the above tests upon a number of successful flying officers engaged upon different forms of aerial work at various flying stations. In addition, a number of successful and unsuccessful pupils were also examined. The results are given in the following Tables:—

TABLE IV.

		Pulse-rate		Increase	Time taken to return to standing rate
		Standing	After exercise		
Flying instruction (29)		87	114	27	20 secs.
Test pilots (17)		84	109	25	25 ,,
Home defence (30)	Low	101	126	25	16 ,,
	High	85	110	25	18 ,,
Successful pupils (17)		85	109	24	21 ,,
Unsuccessful pupils (8)		85	121	36	23 ,,

The figures in parentheses represent the number of officers examined.

Blood-pressure.—The average systolic and diastolic pressures in the series are given below. These were taken with the arm at heart level and also with the arm raised through an angle of 120°. Both the systolic and diastolic pressures were taken by the auscultatory method, the systolic pressure being read preferably at the point of reappearance of the pulse (on coming down after previous obliteration by the armlet pressure).

TABLE V.—ARM AT HEART LEVEL.

		Systolic pressure	Diastolic pressure	Pulse pressure
Flying school		120·6	89·3	31·3
Test pilots		121·4	82·8	38·6
Home defence	Low	119·1	77·7	41·4
	High	122·5	74·9	47·6
Successful pupils		115·7	74·1	41·6
Unsuccessful pupils		122·1	68·4	53·7

From the above observations the following conclusions were drawn:—

(*a*) That the observation of increase of pulse-rate after exercise, and the time it takes to return to the rest rate, is a useful method of testing the functional efficiency of the cardio-vascular system. With the method of exercise adopted an increased rate of over twenty-five and a return period of over thirty seconds are points calling for careful consideration of the candidate's cardio-vascular system. It is to be observed that a rest rate above normal, especially if influenced by respiration, is not regarded as necessarily throwing doubt upon the functional efficiency of the cardio-vascular system. A pulse of 60 to 72 little raised by exercise (ten beats per minute), returning to normal in ten seconds, is in our opinion a good sign, generally associated with excellent physique and good stability of the nervous system.

(*b*) A diastolic pressure below 70 mm. Hg, combined with a pulse pressure greater than 50 mm. Hg, is strong evidence that a cardio-vascular system is unsuited for air work. A consideration of blood-pressure records led to the conclusion that stress of service or high flying almost invariably produces in an individual previously fit a low diastolic pressure and a big pulse pressure, due probably to lessening of vaso-constrictor tone of the arterioles.

Application of the above standards among the various groups examined worked out as shown in Table VI (p. 14).

It should be remembered that recent nerve strain was common among pilots who, in the Home Defence Squadrons, were being subjected to fairly constant stress, but with a period of rest these would undoubtedly conform to the requisite standard. The instructors at flying schools and the successful pupils satisfied this test without exception, while four of the eight unsuccessful pupils would have been rejected on the score of cardio-vascular deficiency. The other unsuccessful pupils were of the nature of the "temperamentally unfit." The test should not be applied rigidly without consideration of other points in the candidate's condition. Indeed, in all subjects failing in the test, particularly borderline cases, other points (soft abdominal wall, splashing stomach, engorged jugular veins, reflexes (brisk or exaggerated), tremors, poor balance, local signs) were considered. In this series it was found that failure to comply with this blood-pressure was almost invariably associated with two or more of these abnormal physical signs.

TABLE VI.

	Number examined	Number of pulse pressure over 50	Per cent. pulse pressure over 50	Number of diastolic pressure below 70	Per cent. diastolic pressure below 70	Number of men with pulse pressure 50+ and diastolic pressure 70−	Per cent. with pulse pressure 50+ and diastolic pressure 70−
Flying School instructors...	29	—	—	—	—	—	—
Test pilots	17	4	23·4	3	17·6	2	11·7
Home defence { Low ...	15	3	20·0	1	6·6	1	6·6
Home defence { Scout ...	15	6	40·0	3	20·0	3	20·0
Pupils under instruction—							
Successful	17	4	23·4	5	29·4	—	—
Failures	8	5	62·5	4	50·0	4	50·0

It may, therefore, be assumed that the ideal pulse for a flying officer has a small range between systolic and diastolic pressures (20-30), with a rest rate increased at most 20-25 by exercise and returning to the rest rate in ten to fifteen seconds.

From the respiratory standpoint the subject must be possessed of good vital capacity and good expiratory force. The accessory "respiratory pump" is of particular importance in the airman owing to the fact that his position is frequently somewhat cramped in the machine. Good diaphragmatic action and good tone of the abdominal muscles are essential to ensure adequate venous return to the heart and prevent any tendency to splanchnic pooling.

The adequacy of the vital capacity can be calculated from the Dreyer formulæ (*Lancet*, August 9, 1919, p. 227). This falls away with the onset of fatigue, and this falling off is associated with a diminution of the supplemental air. In consequence there is an increase in the "residual air," the effect being that a man is very much in the position of a machine running on a "wrong mixture," due to deficient scavenging of the exhaust. Such a man becomes a "panter" instead of a deep breather at high altitudes.

For the assessment of respiratory efficiency the following tests are employed:—

(1) The vital capacity.

(2) The power to hold the breath after full expiration and inspiration.

(3) The height to which a column of mercury can be steadily blown (with the cheeks held).

(4) The time at which a column of mercury can be sustained at 40 mm. Hg, the pulse being counted meanwhile. (For details, *see* Air Ministry Publication C.A. 1; also *Lancet*, February 8, 1919, p. 210.)

Experience has shown that although designed primarily as tests for respiratory efficiency these tests (particularly test No. 4) have also great value in aiding the formation of an opinion as to the stability of the nervous system, and the efficiency of the circulatory system. They are also of service in assessing the mentality of a subject.

It should be remembered that these tests were devised *to serve as adjuncts* to the general clinical examination. It has been found that some purely temporary cause may be the reason of failure in some of the tests and therefore attention should be directed to the subject's performance as a whole rather than to failure in any one particular test. It is also of the greatest importance that the tests be carried out exactly as specified in the directions, and that it be carefully observed whether the subject is really trying to do his best. Results obtained from an individual who is not trying are of little value beyond showing that at the moment he is not "keen" and, therefore, to that extent not thoroughly efficient.

Various considerations led me to the conclusion that the first breakdown in the bodily systems is frequently associated with the respiratory mechanism, which, on becoming defective in working, reacts owing to inefficient respiratory ventilation upon the cardio-vascular and nervous systems, thereby bringing out secondary signs of cardio-vascular and nervous debility. In support of this view, it should be stated that early on it was observed that pilots said to be suffering from stress suffered from breathlessness, and manifested inability to blow hard, or expire deeply. The condition of the respiratory mechanism of successful and unsuccessful pilots was therefore investigated. The first test devised was that of holding the breath. Preliminary figures obtained from successful pilots showed that on an average those officers could hold their breath under the conditions of the test for sixty-nine seconds, whereas many officers who were attending medical boards owing to their inability to fly high, could hold their breath, generally speaking, only for twenty to forty seconds, the performance being usually attended with a considerable degree of discomfort.

Table VII gives the figures obtained in various groups of officers.

TABLE VII.

Subjects	Number examined	Breath held in seconds	Vital capacity in cubic centimetres	Supplemental air in cubic centimetres	Expiratory force in mm. Hg	Sustaining 40 mm. Hg
Fit instructors	22	67*	4,062	1,620	112	52
		46†	3,300	1,000	80	43
Home Defence pilots	24	72	3,940	1,496	119	50
British candidates	23	69	3,823	1,590	106	52
United States candidates ...	7	66	3,814	1,386	116·4	53·5
Delivery and test pilots	10	57	3,620	1,050	108	40
Pilots returned for rest	17	57	3,897	1,423	95	40
Pilots training for scouts	15	62	3,820	1,433	96	49
Pilots taken off flying through stress	27	49	3,480	1,134	74	25
Hospital cases	55	54	3,560	—	87	35·5

* Average. † Minimum.

From the foregoing figures it is seen that for the expiratory force test 80 mm. Hg should be taken as a minimum. For the test of sustaining 40 mm. Hg with the breath held, forty seconds should be regarded as the minimum time. It was found that these tests in combination were of use in indicating the powers of endurance of the subject for high or prolonged flying, and also of value in assessing the degree of shock sustained by a pilot in so-called "minor" crashes. It is significant that during the stage of investigation, a number of subjects found unfit at the Aviation Candidates Board were also found unfit on this test.

The above results show that in the selection of the flying officer by the medical officer much may be done by submitting him to an overhaul as regards normal performance just as a technical officer tests the efficiency of an aeroplane. Evidence is also brought forward to show what attributes are especially to be sought in the selection of a successful flying officer.

War Section.

President—Surgeon Rear-Admiral Sir Robert Hill, K.C.M.G.,
C.B., C.V.O., R.N.

Malaria Problems Pertinent to Prevention.[1]

By Angus G. Macdonald, Major R.A.M.C., M.D.

I give here a sketch indicating some of the problems of malaria. I shall lightly touch upon these to emphasize that malaria prevention will not succeed by the mere enunciation of a principle or by the pursuance of a stereotyped procedure, but is only to be achieved by the common-sense application of the knowledge derived from the study of a wide series of factors.

(1) The *historical and geographical* evidence of malaria is significant and abounds in problems. At the present day the disease is universal in tropical and subtropical countries where topographical conditions are favourable. In temperate lands also its range is wide; and its indigenous limits have been long recognized in an isotherm of 59° to 60° F. Actual evidence of malaria in early historic times is barely to be found; and that it could have been rampant in the East of Europe when the virile Grecian civilization was in its zenith has been doubted. There is evidence, however, in the structural work of the Romans, wherever they went, and in Greece, Macedonia, Palestine, and India, of control over paludic conditions, which we should to-day regard as up-to-date work in malaria prevention. Whether any knowledge of the source of malaria is thus indicated, whether these works were constructed to overcome malaria, or whether malaria existed, cannot definitely be said; but at any rate malaria prevention is undoubtedly foreshadowed. Important modern historical landmarks are: the general recognition of the curative value of cinchona, 1658; the evolution of the discovery of the malaria parasite between 1880 and 1890; and the establishment of the sexual development of the *plasmodium* within an *anopheline* mosquito, in 1897 and 1898.

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[1] At a meeting of the Section, held November 8, 1920.

(2) The *morbidity and mortality* records are the evidence on which the demand for control is based. Probably in no part of the world is accurate estimate of the incidence of malaria at present attainable. The death-rate is very high in endemic country. Sickness is shown in an enormous loss of labour, continuous in tropical communities, mainly agricultural. The extreme effects of the disease on armies have been evidenced in many campaigns, notably in Walcheren, 1809; Crimea, 1854-56; and in the recent German War of 1914-1919. A great mass of evidence of the serious drain of malaria on any population may be furnished; and that evidence, properly authenticated and judicially presented, is the substantiation of the sanitarian's demand for prevention.

(3) In *immunity* we have a possible source of aid to prevention; though progress in taking advantage of artificial immunization is at present practically confined to the bacterial diseases. While there may be evidence of varying susceptibility to the effects of malaria, individually and racially, we have no valid evidence of immunity, natural or acquired. In the general population of large sections of communities in endemic country, parasite infection of 20 per cent. and 40 per cent. has been ascertained. That is obviously a minimum figure; and in epidemic seasons a parasite infection of practically 100 per cent. may be found in localized groups. A spleen rate of 80 per cent. and over has been found in the child population—i.e., children under 15. The facts of varying incubation, latency, and relapse point to a relative susceptibility or immunity. On the accepted numerical explanation of relapse the carrier stage implies a continued destruction of parasites. Relapse, which frequently follows fatigue, great and rapid change of elevation, and exposure to cold, would imply cessation of a relative immunity. Incidentally it may be suggested that the large new formation of erythrocytes which is said to follow similar meteorological and physical changes, may explain relapse—the young erythrocytes, in numbers greatly in excess of normal new formation, being presumably more vulnerable than the old case-hardened cells, and affording sanctuary for merozoites, which otherwise would be destroyed. Experiments on complement-fixation in malaria have given some hope that artificial immunization may come to the aid of control. At present, however, the problems of immunity are not solved; more evidence points to psychical tolerance than to immunity; and nothing tangible is presented as a practical aid to prevention.

(4) *Prophylaxis* in respect of malaria, conventionally implies the attempt to prevent infection by the administration of quinine. In

general two distinct aspects of quinine prophylaxis are confused. First, it has to be proved that quinine has a beneficent action—that it does individually prevent malaria. In the second place, the practicability of the prophylactic use of quinine must be demonstrated. That quinine does prevent malaria has not been proved; that its prophylactic use is utterly impracticable in communities and in armies has been repeatedly demonstrated. In my opinion, no aid to prevention is to be gained from quinine prophylaxis.

(5) The problems of *treatment* are many, and barely reduced by the vast experience and experimentation of war time. Quinine has come through a trial similar to that experienced in the Crimean War; its failings have again been demonstrated, its specific value has been reaffirmed. The conventional usage of practitioners in endemic country has been acclaimed as a discovery—" quinine early, prompt, sufficient, and maintained; intravenous, intramuscular, and subcutaneous in emergency." "Operative" administration of quinine has recently acquired a vogue. This danger in the hands of the exploiter had its justification in war time, when undoubtedly, for obvious reasons, cases of exceptional severity were abnormally numerous amongst soldiers. Modes and amounts need not be considered here. The records of quinine treatment of recent years are voluminous. The problems of treatment and of the action of quinine are sufficient to encourage the explorer, and have the mystic value of the unknown as a counter attraction from mere practical prevention. A modern school of hygienists puts treatment forward in its armamentarium of prevention. So we are told of quinine. But it is pure sophistry to claim treatment as prevention. Incidentally one might suggest the importance of getting at the truth of the splendid absence of enterica from our armies—to be told truly how much of our exemption was due to serums and vaccines, and how much to real prevention—to improved general cleanliness.[1]

(6) A clear understanding of the *parasitology* of malaria is an essential guide to prevention; and this includes accurate parasite diagnosis. From the extensive wartime study of blood films and of plasmodial sexual development no observations have transpired to controvert the conventional acceptance of the three parasites; of the

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[1] Serums were not used in the prevention of the Enterica in the late War. A careful study of the existing records as to the incidence and mortality in inoculated and non-inoculated groups leaves no room for doubt that the "splendid absence of enterica" was chiefly attributable to prophylactic inoculation, though, no doubt, general measures of hygiene played a part.—S. L. C.

actuality of the sexual and asexual cycles; and of the habitat and situation of phases. Some question may have arisen of the actual relation of sporulation to "fever," due to the observation of sporulation during intermission, which has hitherto received the ready explanation of relativity—mass sporulation being associated with pronounced febrile attack, irregular minor sporulation with relatively negligible "fever." There is no evidence that the temperature necessities of the asexual cycle have been studied; and there may be something to be learned of the relation of body temperature to the continuity of the cycle. The raised body temperature, commonly attributed to the action of toxins, may in itself have some effect of an immunizing kind on parasite development; and the undoubted inhibitive action of quinine may in some manner be related to the heat-forming mechanism. The temperature necessities of the plasmodial development in the mosquito have received experimental study; and confirmation of previous work has resulted. Records of the seasonal occurrence, actual and relative, of the different parasites show always an earlier incidence—varying with year, locality, and temperature from one to two months—of *vivax* than of *falciparum* infection. Of *malariæ* infection no estimate of relative occurrence is obtained. The quartan infection was noted as being rare in comparison with its relative frequency among the native population in Eastern Europe. The fact of its localized occurrence was also observed, as it had been in India, Africa, and the West Indies. I have known situations where I could go with certainty to replenish my stock of quartan films, whereas in the surrounding country *falciparum* and *vivax* alone would be found. This suggests the value of a knowledge of the regional distribution of the different parasites and the causes thereof, which would give a new direction to certain operations of prevention.

(7) *Entomology* also affords many problems, the elucidation of which is essential to wise and economic prevention. Much knowledge has yet to be obtained of the bionomics of the *Anophelinæ* generally, though considerable insight into their ways has been gained in war experience. Their seasonal development and seasonal biting and infectivity, in temperate, arctic and tropical latitudes have direct bearing on preventive procedure. There may be continuous anopheline development throughout the year; I have taken larvæ of *Cellia argyrotarsus* in every month of the year in the West Indies, but that does not imply continuous infectivity. In India, for instance, it is common knowledge that the dry season is comparatively, if not in some districts completely, free from primary malaria infection. The records of infection in Mesopotamia

indicate one biting and infective season over three months in spring, and another for three months in autumn, separated by two three-months' seasons of comparative absence of primary infection in winter and summer. In Africa, on oases where mosquitoes abound throughout the year, two epidemic seasons of primary malaria are definitely recognized. In temperate and arctic regions the biting season is brief or absent, and indigenous malaria is recorded as occurring at Archangel, even to the north of the indigenous isotherm. Another matter for investigation specially pertinent to prevention is the specific infectivity of the *Anophelinæ*, particularly for *Plasmodium malariæ*.

(8) In *meteorology* we meet factors vitally influencing the incidence of malaria and the course of prevention. Rainfall has been the most obvious agent. Epidemic extension of malaria follows rain; casual water lies far and wide, in intimate association with the homes of the people. Anopheline development depends on water and temperature. There are latent periods which in some regions appear to be independent of rainfall. The general explanation of the seasonal incidence of malaria has been "rainfall" and mosquito development. During the years of war, however, the enforced study of malaria occurrence in temperate latitudes has drawn attention to the influence of temperature on infection there, and secondarily emphasized the importance of temperature in tropical and subtropical countries, where its equable influence on malaria occurrence was an accepted belief. Epidemiological evidence suggests that a thorough knowledge of the relation of temperature to anopheline development and to plasmodial sporogeny may revolutionize the economics of prevention. It was found in England in the years 1917 to 1919 that infection definitely followed within a month from the commencement and continuance of a period of a mean temperature of 60° F.; and the number of cases corresponded roughly to the length of the valid temperature period.

Year	Temperature period of 60° F.	Malaria occurred	Number of cases (military)
1917	June, July, August	From early July	163
1918	July, August	From early August	61
1919	August	At end of August and early September	6
1920	Discontinuous in August	—	None

The experience of 1917 and 1918 led to confidence in forecasting the occurrence of indigenous cases in 1919, which were reported on the exact days foretold. While 60° F. is reached in England for a limited period most years, the date and extent vary. The latitude is definite, north of which (about 54° 30′, in the neighbourhood of Hull and York) this mean temperature does not occur for the necessary length of time. The neighbourhood of Grimsby has been the furthest north locality of occurrence of an indigenous case in England in recent years. Indigenous cases have occurred in England, and even in Archangel, when the temperature of the air was well below 60° F. In every instance the human source of infection, *Anopheles maculipennis* the vehicle, and an indoor temperature sufficient for the maturation of sporozoits were present.

The minimum mean temperature necessary to ensure infectivity is not known;, it probably is not much below 60° F. Nor is the maximum mean temperature for infectivity known. It is probably some degrees below 90° F. There is experimental and epidemiological evidence to indicate that temperature decides the seasons of primary infection in a very definite manner; that in India, for instance, there is a season too hot (varying in different years) for malaria infection; while in Mesopotamia, there are a season too hot and a season too cold for malaria, with short three months' infective seasons between, for the maintenance of carriers. The fact of the sexual plasmodial elements forsaking the human blood at 98° F. is certain indication that sexual development will not take place at that temperature, if temperature has the ruling. We seem to have in temperature also the true explanation of the seasonal relativity of *falciparum* and *vivax* infections. Of *malariæ* the indications are at present vague. Only *vivax* infections have been got in England. *Falciparum* infection comes on in Eastern Europe a month or more after *vivax*, the dates corresponding to the advent of higher temperature. The problem is fascinating. Much more extended study and experimentation throughout the world are necessary to determine the maximum, minimum, optimum, and range of temperature (which range may be more limited for one than another) of the different malaria parasites. Reports from seats of war afford suggestive epidemiological evidence; but in Mesopotamia particularly the reports deal with so wide an area, over different periods of occupation, and in varying latitudes and seasons, that it is not easy to obtain a clear picture of occurrences. The problems are many and promise, when solved, to revolutionize prevention.

(9) The *personal protection* afforded by nets, screening, clothes, is a distinct aid to prevention. Its value is however limited in communities and in armies. Much improvement is required to enhance its efficacy. Culicifuges have been proved of little use and are expensive, and demoralizing in their suggestion of security.

(10) In *mosquito destruction* we have at last PREVENTION. While it cannot be said that anything entirely new in mosquito destruction has been introduced in war time, two measures have had their value emphasized as a result of the experience in different parts of the world. The attack on *imagines* has been established as a certain factor in limitation. In England indeed observation over three successive seasons indicates that persistent attack on *imagines* of *Anopheles maculipennis* during one season may bring about local elimination. In one situation where the record was "myriads" in the winter of 1917-18, scarcely a mosquito was to be found during the three succeeding seasons, winter or summer. In the same neighbourhood undisturbed conditions remained the same over the same time. The extension of a more concentrated attack on *imagines* to tropical countries demands more accurate knowledge of habitat, and of the relation of seasons and temperature to anopheline development. Another measure of destruction which has received fresh impetus from recent experience is the simple "conversion" of waters, whereby, in the removal of favouring and the maintenance of unfavourable conditions, practical elimination of anopheline breeding is attained, by labour alone, independent of adjuvants.

I have brought together a few of the problems facing the student of malaria, and have given my estimate of their pertinence to prevention.

DISCUSSION.

Lieutenant-Colonel F. E. FREMANTLE, M.P.: I was surprised at Major Macdonald's reference to the records of the Mesopotamian campaign. Having served there in charge of sanitation as D.A.D.M.S. (Sanitation) at Qurnah, Amara, and at the Base for the last two years of the war, I know how carefully records were kept. Every week from each station on the Lines of Communication a Progress Report was sent to General Headquarters, with precise statistical and practical records. Major Christophers, I.M.S.—one of the chief world authorities on malaria—made special inquiries and reports on the subject in every area under military occupation, and the whole were co-ordinated and constantly used for effective purposes by Colonel Graham, I.M.S., the A.D.M.S. (Sanitation) at Baghdad, who is now on leave in this country and would no doubt assist Major Macdonald to make use of what was probably a quite unique experience of the malaria problem. For, as Major Christophers said to me, there was probably no experience in the world, not even excepting that of the Panama zone, equal to that of the huge military base at Basrah for the completeness of the measures taken and effects recorded for the prevention of malaria. On the pathological question may I suggest that the discrepancies with regard to the relations between temperature and malaria incidence may be due to the omission of the humidity factor. Certainly with regard to heat stroke it is not the mere temperature of the air that matters: but the cooling effect of the air on warm-blooded man. This involves the three factors of temperature, moisture, and movement of the air, recorded together by Professor Leonard Hill's catathermometer in the cooling effect per square centimetre of surface. This is the only thing that directly matters with regard to the relation between climatic temperature and human health, and the use of the catathermometer should be taught and practised in all military and other Government establishments in warm climates. If it has not already been done, an investigation should be made into the relations of catathermometry and malaria prevalence. With regard to practical prevention we developed at Basrah a most necessary and valuable association between hospital records and the work of sanitary sections. In the ten great hospitals at the Base we organized a systematic record of the exact origin of primary infections of every case admitted to hospital. This weekly return was submitted to Major Christophers (in charge of the Central Laboratory) and distributed to the five sanitary sections at the Base, enabling them to complete the malarial topography of their respective areas, and therefore to take specific action for the extermination of the less obvious breeding grounds. This work was largely carried out, under proper supervision, by Indian and even Arab followers. This association between hospital records and sanitary sections is of immense importance to the work of both, and should become a prominent part of military, and probably indeed of all, sanitary administration. So far as I know it is not at present provided for in military regulations. Finally, I would emphasize the immense value of malaria as a complete picture and lesson in preventive medicine. Down to considerable detail each part of the picture is complete, the chain of connexion from ætiology to prevention is proved. It should be taught as a lesson to every medical student, above all to every student of public health, whether he intends to practise in the tropics, to serve in the Army or other Government administration abroad, or even if he intends, so far as he knows, to practise general medicine at home.

Lieutenant-Colonel P. H. HENDERSON, R.A.M.C.: I served nearly three years in the Vardar and Struma Valleys in Macedonia and later for a further period of nine months in South Russia, in all of which places malaria was very prevalent. With regard to prevention, some people are apt to discard various recognized methods, because none of them are in themselves perfect. In the front line in war none can be perfect, but much can be done to reduce the risks and degree of infection by making the utmost possible use of all available methods. For instance, in the Struma Valley the draining of the marshes would have occupied the whole Army for years, yet local drainage schemes reduced to some extent the numbers of anophelines and so diminished infection. Another valuable method of killing off mosquitoes was by attacking them in their hibernating quarters and catching them in suitable traps adjusted to certain windows or by killing them in windowless rooms by fumigation. Situated as we were for the greater part of the time in holding a fixed line, I consider the best means of individual protection was by means of mosquito-proof dug-outs, dining and recreation huts. Bivouac mosquito nets, as issued to the Salonika Army, were useful at night, particularly on the march, as they enabled the troops to get a peaceful night's rest, but as the type issued could not be made rainproof, and as mosquitoes were frequently most ravenous about the tea hour and before the men normally retired to rest, their value under the existing conditions could not be compared with proofed dug-outs and huts. Protective clothing in the form of turned down drill shorts and gauntlet gloves were of no great value as mosquitoes readily bit through them. Similarly the various substances advocated for application to the skin were more or less valueless, the length of time for which they were efficient depending on the temperature of the body and the amount of perspiration.

Quinine as a prophylactic was, in my opinion, not only useless but dangerous, as it interfered with subsequent treatment and after a prolonged course upset digestion and lowered the vitality and resisting powers of the troops. Major Macdonald is in doubt as to whether there is such a thing as individual immunity. I myself believe in it, as I do not mind now confessing that I took ten grains of quinine prophylactically only on one occasion as an example to other officers in the mess, when all ranks were ordered to take prophylactic quinine daily. Although I was very frequently bitten by infected mosquitoes, I was one of the very few in the Struma Valley who never suffered from malaria. My blood has been tested with negative results. My A.D.M.S. who was also a disbeliever in the prophylactic use of quinine was less fortunate. He contracted malaria, but as he had not soaked himself with prophylactic quinine, he was readily cured by taking quinine by the mouth.

Major Macdonald appears to be uncertain as to whether improved sanitation or antityphoid inoculation was the cause of the reduced incidence of enteric fever during the recent war. No one who experienced the conditions at the front during the war will hesitate in saying that it was chiefly due to antityphoid inoculation, while improved methods of sanitation only contributed in a slight degree. I am further of opinion that until bacteriologists can devise some means of similarly increasing malarial antibodies you will not arrive at a really reliable means of preventing malaria, at any rate in an army serving under conditions similar to those met with in the Struma Valley. I have never seen it stated whether the malaria which decimated the troops in the Walcheren Expedition was of the malignant or benign type or a combination of both. In pre-war days in India, I never knew of any troops dying of benign tertian malaria, whereas in Macedonia the majority did die from this cause. What is the reason of this? Is it due, as stated, to the continuous and massive infection acquired there, or is it not due to a particularly virulent parasite produced as a result of the frequent passage of the parasite from man to man? It was noticed that the mortality increased as the malarial season advanced. With regard to the carrier of malignant malaria I noticed that cases of this variety did not appear till comparatively late in the season, usually about August, and that they generally increased in number as the season advanced. Similarly *Anopheles superpictus*, while rare early in the season, became much more prevalent as the season went on, possibly a coincidence, but has this matter been investigated?

With regard to treatment, a distinguished officer carried out investigations on early and late cases in the Field Ambulances in the Division. He used to give 1 gr. per pound body weight, intramuscularly, intravenously and by the mouth. At first his results seemed to be most promising, but later relapses appeared in a considerable number of the cases so treated. It struck me, however, that as these cases were probably reinfected there was no reliable evidence as to whether the subsequent attacks of fever were relapses or merely the results of fresh infections.

In conclusion, will Major Macdonald state what is the minimum period during which a mean temperature of 60° F. must be maintained to enable the malarial parasite to carry out its cycle in the mosquito?

Rear-Admiral P. W. BASSETT-SMITH, R.N.: In reference to Major Macdonald's rather sweeping condemnation of the prophylactic use of quinine: in the Navy for many years the use of quinine, as a preventive measure, has been regarded as most useful in reducing the incidence of malaria, and Surgeon-Commander Morris, O.B.E., R.N., who was our malarial expert in the Ægean, recommends it as a prophylactic with other preventive measures. Surgeon-General Rho has definitely stated that in the Italian forces it was a powerful prophylactic, and quoted a force in Northern Italy which suffered very severely in the first year, about 90 per cent. of cases, when the drug was incompletely administered; with more careful supervision the incidence fell to a very low point, 10 to 15 per cent., while neighbouring units not so protected maintained the high rate. I do not wish to minimize the value of prevention of carriers by reducing the mosquitoes, but there are positions where this cannot be carried out; then the administration of quinine is absolutely necessary. With regard to immunity this is of two kinds, one, a total immunity, and secondly, an immunity to the toxin; any one with experience in the tropics must know cases in which old residents, though infected with parasites, suffer hardly any clinical symptoms. With regard to temperature, Dr. Plehn, in discussing the unity of malarial species (in which I do not believe), lays great stress upon temperature in bringing about this change of the parasites. With reference to the indigenous malaria in England, our naval records are in close relative accordance with those stated by Major Macdonald, twenty cases in 1917, eight in 1918. four in 1919 and none in 1920.

Lieutenant-Colonel W. BYAM, R.A.M.C.: With regard to the question of immunity, if we have even the slightest evidence that any immunity to malaria may exist, or be developed, the study of its production is well worth while as likely to prove of value in connexion with prophylaxis. This is so because the destruction of mosquitoes is often impracticable under military and, more particularly, under active service conditions. How does Major Macdonald explain the relative immunity to the effects of malarial infection one sees amongst the adult Sudanese as compared with the Egyptians transported to the Sudan? To take Egyptian troops to certain areas of the Sudan is inevitably to render them unfit for military service owing to the effects of malaria, and this while Sudanese troops serving alongside them, and under similar conditions, are able to work regularly, even though parasites may be found in their blood. It is not a question of racial immunity, the Sudanese child is prone to infection and suffers from it, the infection persists, but the symptoms largely disappear. Is not this evidence of a developed immunity to the malarial toxin at least? My second point concerns quinine prophylaxis. We are agreed, apparently, that the taking of quinine will not prevent infection, and, though the point has not been raised, we probably all agree that the administration of quinine will reduce the number of malarial parasites in the peripheral blood almost to vanishing point. Now as far as we know there is no reservoir of human malarial parasites other than man from which mosquitoes can be infected. This being so, is not quinine prophylaxis likely to be of great value when not only troops but all persons in their neighbourhood are adequately quininized. If such a measure is carried out immediately a mosquito-infested area is entered, from whence can mosquitoes become infected? Followers, porters and similar persons are frequently neglected in this respect. Some years ago I had an opportunity of supervising an Egyptian battalion which was receiving careful quinine prophylaxis, the administration being commenced before the fever season began and before anophelines were observed. The barracks occupied was isolated in the middle of a plain. Later, anophelines became plentiful and, having entered the barracks, they apparently remained there, but malaria did not appear. At this time all new arrivals at the station were examined for malaria before passing to the barracks and, if necessary, detained in hospital. On one occasion soldiers slipped through and avoided antimalaria treatment before reaching the barracks; infections with malaria resulted in their immediate neighbourhood and were subsequently followed by other cases. The men taking their prophylactic quinine escaped malaria in spite of plentiful mosquitoes only so long as the source from which the mosquitoes could become infected was excluded. If quinine prophylaxis includes every inhabitant of a given area it must produce an effect, but to give troops quinine and to allow the civil population around them to go untreated is useless.

Major-General Sir WM. MACPHERSON, A.M.S. (ret.): Major Byam's remarks regarding the absence of any general measures for treating or cinchonizing civil populations in an area of operations need correction. When the Expeditionary Force of French and British occupied the Salonika perimeter, early in 1916, I arranged in conjunction with the French medical authorities a malarial survey of all the Greek villages within the perimeter. We took the splenic indices in each and found out which were foci of infection. We then systematically administered quinine, under supervision, to the civil inhabitants. This was thoroughly done, large quantities of quinine being used. We began this very early, about February, 1916, I believe; but this system of cinchonizing the civil population was combined with every other possible measure of eliminating malaria from the perimeter and preventing infection of the troops. Major Macdonald properly emphasized the importance of destroying the *imagines* of the mosquito. In 1911 the importance of this was illustrated in Hyderabad, Scinde, during a severe outbreak of malaria in an Indian regiment there. I obtained authority to have all the barrack buildings and other buildings dealt with according to the methods employed for destroying mosquitoes in blocks of houses by the Americans in Cuba. This involved covering the roofs and outside verandahs with canvas or tarpaulins, and sealing chimney openings before fumigating the space enclosed. The results were immediate, not only in checking the epidemic, but also in causing an enormous diminution in the subsequent incidence of malaria in Hyderabad. This measure was associated with other recognized methods of malaria prevention, but I attribute the checking of the epidemic to the wholesale destruction of the mosquitoes, harbouring in the infected buildings, not only in the rooms but in the chimneys and in the dark corners of roofs and verandahs outside the rooms.

Major MACDONALD, R.A.M.C. (in reply) said that he was sorry Colonel Fremantle had had to leave before hearing him express regret that his lack of perspicuity had given Colonel Fremantle a wrong impression of his interpretation of the reports from Mesopotamia. As a matter of fact these were amongst the best reports available. His intention was to express his own inability so to correlate the valuable material in the reports as to get the true picture of malaria incidence in respect of latitude, seasons, and temperature. Much observation had been made of humidity. They found that biting and infectivity seemed to go on with equal certainty when there might be 20° and 30° of difference between the dry and wet bulbs as when the difference was but a few degrees—temperature conditions being favourable. It was possible that at certain high temperatures attained in Mesopotamia mosquitoes might be actually desiccated; but it was not obvious that humidity, *per se*, would affect the malaria process in mosquitoes obtaining their normal food. The influence of "humidity" was often discussed in a vague way. There might be some implication of its influence which he failed to understand, or which he had not seen explained. Colonel Henderson and himself would need a whole night to argue the respective values of antibodies and mosquito destruction in malaria prevention. The plasmodial incubative period, by the way, in this country at a mean temperature of 60° F. seemed to be about sixteen days. Infection was set up after sixteen days of a continuous mean of 60° F., and the onset of disease was within twelve days. So that roughly a month or twenty-eight days had been taken in England to cover the time from mosquito infection to the next onset of malaria. Colonel Byam would admit that the occurrence he cited to establish the theory of racial immunity was susceptible of other explanation. Major Macdonald did not wish to strain discussion on the academic question of absolute and relative immunity; he was talking here of immunity of practical value in prevention. The observations of Rear-Admiral Bassett-Smith were interesting, and he would be glad to discuss the question personally with him. It was important to have heard General Macpherson's testimony of personal experience in Macedonia of the recognition there of the value of prevention in the destruction of imagines.

War Section.

President—Surgeon Rear-Admiral Sir ROBERT HILL, K.C.M.G.,
C.B., C.V.O., R.N.

The Best Form of Instruction for Medical Students to fit them to take their part in Case of National Emergency.[1]

By H. E. R. JAMES, Lieutenant-Colonel R.A.M.C., C.B., C.M.G.

IN introducing this subject for discussion, I propose to state what is being done, and to invite suggestions for the modification or improvement of the course of instruction.

I would *first* postulate that the Officers Training Corps, now fully established and organized, should be accepted as the organization under whose ægis the training should be carried out. Its machinery is complete and it has come to stay.

The national emergency is of course War. There are many minor emergencies, however, which may be encountered in the course even of civilian private practice in which a training, calculated primarily to make a practitioner fit for field service as an Army Medical Officer, will be of value, particularly to a medical man who enters any form of State Medical Service.

Secondly, the training must be carried out in the leisure time of the student (although the formation of an "Army Class," with a special curriculum including military medical subjects, would be very helpful). The present medical curriculum, calculated to make a student efficient in carrying out duties to the sick in civil life, is sufficiently intense and exacting to render it unfeasible to add compulsory auxiliary subjects to those considered essential; so that the training must be voluntary,

It takes up the time which the less patriotic or provident student devotes to games. Therefore the instruction should be as recreational as possible and calculated for the mental enlargement as well as the physical culture of the student.

It should be adapted to help him in whatever career he adopts, so far as is compatible with its main object.

MEDICAL UNITS, OFFICERS TRAINING CORPS.

The Medical Units, Officers Training Corps, form one of the branches of the Senior Division of that body, of a specialist type.

For the information of those who have not been brought into touch with the subject of the Officers Training Corps, I will state shortly its nature and functions.

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[1] At a meeting of the Section, held March 14, 1921.

It was formed in 1908, during Lord Haldane's Secretaryship, by a committee of school and university teachers under the chairmanship of Sir Edward Ward, then Permanent Under-Secretary for War, with the object of giving a standardized measure of training in military matters to students at schools and universities such as would fit them to become officers of the Army, S.R.O. and T.F. It absorbed existing Volunteer Corps at schools and universities. It consists of Junior and Senior Divisions; the Junior Division at Public and other large schools, the Senior Division at Universities and the Inns of Court. The officers in the Junior Division are schoolmasters, in the Senior Division members of University Staffs, and in both cases are on the unattached List of the Territorial Force.

In the Junior Division, Infantry training alone is given, with the exception that in two schools some R.E. work is taught to the senior cadets.

In the Senior Division, though Infantry training is the staple, units of Cavalry, Artillery, Engineers, Signals, R.A.S.C., R.A.M.C., R.A.V.C. are formed and the special duties of these branches are taught in units of the Contingent, of the formation of corresponding units in the Army. The training is carried out under the supervision of the Chief of the Imperial General Staff, by the officers of the several contingents in term time and in annual camps. Adjutants who are attached to the General Staff are appointed from the Regular Army to contingents, and N.C.O. instructors are supplied. Equipment, arms and uniform are also found by the public in kind or from grants.

Cadets serve under a contract with their Universities; they are not subject to military law, and enrolment is voluntary.

The affairs of University Contingents are administered by a Military Education Committee of the University where they exist, and the War Office assists the Committee, as necessary, in carrying out their work. Attendance at a certain number of instructional parades is necessary to qualify for efficiency. Annual Camps are held, and the training is made as practical as possible to fit the cadet for war service conditions as an officer. Two certificates are obtainable by examination.

One year's training is the minimum to admit a cadet to sit for Certificate A, and two years for Certificate B. Only Certificate A is obtainable in the Junior Division, but in the Senior Division both A and B.

The possession of these certificates gives the holder certain definite privileges if he should choose the military career. But the real value of the organization is that it disseminates military knowledge among a large body of the class of men best fitted to hold commissions and prepares them to take their places as officers in time of emergency, with a minimum of preliminary instruction.

The Officers Training Corps comprises a very large body. Twenty-one Contingents exist in the Senior Division and 162 in the Junior Division. The value of the training was fully proved in the War. Had it not been for the Officers Training Corps output it would have been impossible to supply the Army with junior officers. It is not too much to say that it saved the situation on the outbreak of war.

As to the particular affairs of the Medical Units, they have been formed from medical students as units of the Senior Division Contingents with a view to training them for the Military Medical Services. The Training Unit is a section of a Field Ambulance, that being the War Unit which gives the best opportunity of visualizing the functions of the Medical Service in the Field. Such units have been formed at the Universities of London, Oxford, Cambridge, Dublin, Belfast, Edinburgh, Aberdeen and Glasgow, at which centres the larger medical schools are located. It is hoped that other units may be formed at other medical schools, but this cannot be sanctioned at the present crisis in national financial affairs.

Before proceeding with details I may state that some 5,000 medical students were trained before the War in these medical units. A proportion of them took commissions in the Special Reserve and Territorial Force. The remainder—all such as were qualified—served in the capacity of Medical Officers in the Navy or Army, and the value of their O.T.C. training was attested both by the officers whose commands they joined and under whom they served, and by themselves. The value to the Army of this body of trained medical officers was immense. It is not enough for a medical man, in order to develop his full usefulness in the Army Medical Service, to be in possession of a medical qualification and to have added a measure of military science whether during a course at a Training Centre or in another arm of the Officers Training Corps than his own. It is true that a knowledge of discipline and leading, and the action of other arms, in addition to his medical qualification, will make some sort of an Army Medical Officer, but it is not quite to the point, because the Army Medical Service is a highly specialized branch of the medical profession, and although its primary function is to aid the fighting power of the Army by keeping the largest possible number of soldiers fit to fight, yet its essential aims are conservative, whereas in the fighting branches they are destructive. The two points of view are essentially opposed to each other, and the training shapes the mind to one or other aim. Moreover, it is a waste of time and money to train a cadet, whose services in war would be certainly best, and perhaps only, used in the Medical Service, in the work of a fighting arm, and it vitiates his point of view. There is enough important military medical knowledge to be acquired throughout a Medical Cadet's training in a Medical Unit to take him all his training time to assimilate. This work has a direct bearing on his duties as an Army Medical Officer. It is such as is not acquired during his purely medical curriculum, though much of it would aid him in his civil practice—for instance, first-aid and sanitary and administrative work; and the method of its conveyance is far superior to that of a condensed course such as is undergone at a Training Centre, since it is spread over a longer period and given in assimilable doses.

There is another important advantage in the existence of a Medical Unit at a University, which is that it keeps the Army Medical Service in the eye of the public of the University.

The Army Medical Service in time of peace is a body little known to that public, and from time to time good students have not only not been encouraged to join, but actually discouraged by their teachers from doing so. The War has been responsible for bringing the work of the Corps to the knowledge of the medical profession, and there exists a large body of medical men who have been trained in war, and who may be counted as available for service in case of emergency for a few years. But the Officers Training Corps is for the purpose of training the young men during their University education, and is a provident institution. It is the only piece of mechanism in this country that provides a reserve of potential medical officers for the Army, and for this reason alone it deserves all the encouragement it can get.

The course of training, as has been said, is shaped to fit the medical student, on his becoming qualified, to undertake the duties of a junior officer of the Army Medical Service in the field, at the least expense of time or even with no preliminary training at a Centre, and to make him as nearly as is possible in the time equal in essential matters belonging to war conditions, to the young medical officer of the Royal Army Medical Corps. He cannot, naturally, have acquired an equal knowledge of hygiene, tropical diseases, drill, discipline, interior economy, &c., in which the Royal Army Medical Corps Lieutenant has had a six months' course at Aldershot and the Royal Army Medical College, and to which all his time has been devoted, but he will have gained enough to enable him to grasp the ideas underlying his work, its general direction, and many of its necessary details.

The course given in the Officers Training Corps to enable the cadet to enter for Certificate B lasts for at least two years; for Certificate A one year.

During the first year, before he has entered upon the professional subjects of his medical curriculum, such as surgery and medicine, he is taught the military part of his duties and a certain amount of elementary sanitary work, and such portions of the work of a medical officer as do not involve the knowledge of his medical specialty.

The cadet of the infantry is at this time learning to be a platoon leader, and the medical cadet acquires such knowledge of squad and company drill and ambulance drill, map reading, and elementary military law, as will make him efficient in the matter of leading and commanding the men who will be committed to his charge.

He also learns bandaging and the application of splints, tourniquets and field dressings, the contents of the medical panniers, means for the purification of water for the troops, tent pitching, field cooking and the construction of extemporized structures used in camp sanitary conservancy, in which particulars he has to instruct his men. During the annual camp he puts them into practice. He receives instruction in the outlines of Army and Army Medical organization by lecture, in order that he may appreciate his particular sphere of activity and his responsibilities as an Army Medical Officer. He has to attend a fixed number of instructional parades, and the annual camp, to attain to being "efficient." He is expected to supplement such instruction by a study of certain text-books of regulations.

Before sitting for Certificate B he undergoes a second year at least of Officers Training Corps training of a kind which involves some knowledge of medicine, surgery and hygiene. This is intended to fit him as a Medical Officer in charge of a unit other than medical and as a junior officer of a Medical Field Unit.

The teaching embraces organization and administration—the structure and functions of medical units; military law; hygiene—including prophylaxis against diseases of armies, methods of disinfection of quarters and clothing, water purification, personal hygiene, field sanitation, sanitary survey of camps, &c.; means of transport of sick and wounded and improvisations to supplement existing conveyances; the medical aspect of marches and movements of troops by rail and sea and the housing, feeding and clothing of troops.

Opportunities for physical training exist in contingents, and where there are facilities cadets are encouraged to learn to ride.

Instructional stores are provided at contingent headquarters, being specimens of the vehicles, tentage and ordnance and medical stores of a field ambulance, for use in demonstration and practice during term time.

In the annual camp, which the cadet attends for eight days at least, the unit obtains from the Command in which the camp is held vehicles and horses and stores to make it up to the establishment, and it is exercised on a scheme devised to demonstrate its working under war conditions.

During term time, when possible, tactical schemes may be carried out to illustrate the interworking of the unit with other units and arms.

The whole training is designed to give the cadet a comprehensive outline of the work of an Army Medical Officer in war, with as much useful detail as possible, and to enable him to instruct his subordinates. He must know enough of discipline and procedure to relieve him from embarrassment on entering his new sphere and to develop his full usefulness, enough of drill to enable him to move his men correctly and give him confidence, and enough of interior economy to enable him to deal with matters concerning the well-being of his men and patients.

The advantages of such training from the point of view of the State are considerable, in that it provides a reserve of potential medical officers possessing adequate knowledge of the duties they would have to perform in war to make them of the fullest value from the time of their joining.

The advantages to the cadet are also considerable. He acquires, at no expense to himself, except that of some leisure time, an insight into subjects which in the event of his joining a State Medical Service are of supreme value, and, should he take up private practice, will fill gaps in his ordinary curriculum and be found very useful.

These are (1) elementary practical hygiene, which makes a good groundwork for its more intimate study. (2) First-aid methods, and the transport of sick and wounded and improvisation in this connexion. (3) Organization and methods of administration, a knowledge of which enables him to deal with masses as in railway accidents, mine disasters, &c., and to conduct his affairs with method. (4) Discipline, an understanding of which will serve him in all the amenities of life and in dealing with subordinates. (5) Map reading—an accomplishment of practical use in every day life, the application of which to sanitary surveying and inspection will be found very useful by a medical officer of health. (6) Drill and ambulance drill, which put him in the way of directing his assistants in carrying out any combined operation, such as placing a patient upon a stretcher or in a vehicle.

In addition to these pieces of knowledge, the cadet gets an annual airing in camp without expense, and with the greatest benefit to his health. He is a member of a corporate body within the University and his social relations with his comrades are of the pleasantest and most healthy kind.

To the University in whose Officers Training Corps contingent he serves, the organization is of value from the fact that it has a body of students bound together by the ties of discipline and comradeship, who are working with a high aim for the welfare of the State and who set the best kind of tone in the University, and influence others by their example. (In a non-resident University this is particularly valuable.) The training fosters habits of punctuality and the realization of duty and responsibity.

The war record of the Medical Units is a very fine one and has amply established the value of organization and training. Unfortunately records are not complete, but of a body representing about a quarter of the whole number of Medical Officers, of all services and categories, who trained in these units—Royal Naval Medical Service, Royal Army Medical Corps, Special Reserve of Officers, Territorial Force and temporarily commissioned officers—1,178 in number, whose records have been obtained, 95 gave their lives, 176 were decorated and 114 mentioned in dispatches, a testimony to their devotion and efficiency and an example to the rising generation of students.

At the present time the prospects of the Senior Division of the Officers Training Corps, and particularly of the Medical Units, are at a low ebb, for the following reasons:—

(1) A general feeling of war weariness and an idea (fostered by the hope) that there will be no more war in the near future.

(2) The fact that most of the present generation of medical students have served and do not feel disposed to give their leisure time to further military training under peace conditions. This reacts upon the younger men who were not of military age during the war.

(3) Certain very acute grievances which affected those former cadets who had taken commissions in the Special Reserve of Officers and Territorial Force during their war service. The most poignant of these grievances concerned the better pay accorded to medical men who took temporary commissions at consolidated rates of pay, 24s.—the Special Reserve of Officers and Territorial Force Officers only getting 20s. inclusive of their allowances, which allowances they dropped when on leave or in hospital. Other grievances were (*a*) the reluctance experienced in the granting of even temporary rank to officers of the Special Reserve of Officers and Territorial Force, as compared with temporary officers, owing to the fact that seniority lists in the Special Reserve of Officers and Territorial Force were adhered to and were of a permanent nature, whereas, on demobilization temporary officers would be clear of the military establishment, and (*b*) the ignoring of the previous training of Officers Training Corps or cadets on posting. This was due to the anxiety and hurry of mobilization.

(4) During the war it was compulsory upon all students who were held back to continue their studies, or who were physically of low category, and for these reasons not called to the colours, to join the Officers Training Corps. This brought a number of reluctant men into the Medical Units. The reversion to the voluntary system was the signal for these men to break away.

(5) Those who had had their studies interrupted during the war felt it necessary to give the whole of their time to their professional work and to make up the time lost, in preparing themselves to earn their livelihood in civil life.

(6) A doubt as to whether it is worth while, and a question as to the tangible advantages to be drawn from the training.

The remediable causes of disinclination have after representation been remedied and the following measures enacted:—

(1) In future all commissions will be in the Special Reserve of Officers or Territorial Army; this abolishes the giving of temporary commissions carrying higher rates of pay and obviates the setting up of a standard of comparison which was so unfavourable to Special Reserve of Officers and Territorial Force officers under former conditions.

(2) Six months' seniority will be given to officers who, on joining the Special Reserve of Officers and Territorial Army, possess Officers Training Corps Medical Certificate B, and three months to holders of Certificate A.

(3) A credit of 6 per cent. of marks to holders of Medical Certificate B and 3 per cent. to holders of Medical Certificate A will be accorded at the entrance examination to candidates for Royal Naval Medical Service and Royal Army Medical Corps.

(4) Preference in the matter of posting and promotion will be given to

officers in possession of Officers Training Corps certificates over those who have not trained who apply for service in the Medical Branch of the Army. (Card records of the Officers Training Corps services of Medical Cadets are now kept by the D.G.A.M.S. for reference.)

The other causes of reluctance should in time disappear, provided always that encouragement is given to students at the Medical Schools to undergo the training.

DISCUSSION.

Sir **CHARLES BALLANCE** agreed that it was desirable to train medical students in the medico-military service and emphasized the disadvantages from the lack of such training, as experienced by himself, on joining the Field Army.

Mr. H. **WANSEY BAYLY**, M.C., considered that there was urgent need for all medical students to receive some course of instruction in duties which they might be called upon to fulfil if called up for war service. He very much doubted Colonel James' statement that in future wars, only those medical men belonging to the Reserve of Officers, or the Territorial Force, would be called up, as he believed that in the future, as in the past, temporary officers would have to be employed.

Lieutenant-Colonel H. L. **EASON** considered that all medical students should undergo medico-military training, but that the time had not arrived when it would be possible to effect it.

Major T. B. **LAYTON** thought that it was not possible to teach medical cadets the whole of the subjects set down in the syllabus of training, but that it was desirable to concentrate upon some of them, such as shock, collapse, transport of wounded, administration, military law, hygiene of the march—with reference to weights carried and water discipline, infestation by lice, food, examination of recruits. Medical tactics should be taught to senior cadets and office details should be avoided.

Major A. M. H. **GRAY** considered that the best course of training for a medical cadet would be in a combatant branch of the O.T.C. for the first period and in a medical unit for the second period. This, however, was not always possible, owing to the distance of medical schools from infantry training centres.

The **PRESIDENT** (Sir Robert Hill), in summarizing the points raised in the discussion, remarked on the disinclination of the present generation of medical students to undergo any form of military training, disinclination extending in his experience to the R.N.V.R., and no doubt due primarily to a feeling of war weariness, but also due to the grievances experienced by men who had undergone training before the war and had gained nothing thereby. It was hoped that this apathy would in time disappear.

Dr. C. H. **MILLER** said that teachers in civilian hospitals might well point out that the object of the Army Medical Service was, as Colonel James had already stated, to keep as many men as possible fit for duty. In civilian hospitals students were accustomed to see their chiefs demonstrate, at great length, interesting cases which became still more interesting post-mortems; whereas in the field it was the minor malady and the slight wound that were important. A compound fracture of the femur rendered a man useless to the Army for many months, if not permanently; and therefore from the Army point of view he was less important than a man suffering from I.C.T.

Colonel **JAMES** (in reply) said that the specific grievances complained of had now been settled by legislation, and he hoped that those members present who had dealings with students would encourage them to do their moral duty by training themselves for possible national emergency.

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War Section.[1]

President—Surgeon Rear-Admiral Sir ROBERT HILL, K.C.M.G., C.B., C.V.O., R.N.

The Biology of Epidemic Influenza, illustrated by Naval Experience.[2]

By SHELDON F. DUDLEY, O.B.E., M.D., Surgeon-Commander, R.N.

WITHOUT going deeply into the question as to whether *Bacillus influenzæ* was the cause of 1918-19 pandemic, I will at once say my own experience points to Pfeiffer-like bacilli being the cause, or at any rate a very important factor in the ætiology of influenza outbreaks. During 1918, 1919, 1920 and this year I was able to demonstrate *Bacillus influenzæ* in practically all cases examined during the febrile period. The only cases in which I failed to do so were the spring cases of 1918, when I was using an unsatisfactory technique. Besides technical difficulties with culture media which are very real, as I know to my cost, there is another explanation which may possibly account for the reported absence of *Bacillus influenzæ* in certain of the epidemic cases. There are many contributory factors on which the magnitude of epidemics depends, in addition to a specific germ and a specific susceptibility of the population. It is reasonable to suppose these non-specific factors favour the dispersal of many other micro-organisms as well as the virus of influenza. Also, influenza is a disease that undoubtedly renders its victims more prone to invasion by other pathogenic bacteria that happen to be in the environment at the same time. It is quite possible that, in some cases, after a period of association with the influenza germ, some of these secondary organisms increase their infectivity and acquire the power of causing local outbreaks unassociated with the specific cause of the main pandemic. Thus small epidemics are produced within the main pandemic and are unlikely to be differentiated from it, especially when one considers the indefinite symptomatology of a disease like influenza, the diagnosis of which has often to be made by the process of excluding other diseases, together with the fact that influenza happens to be epidemic at the time. These reasons, and the fact that *Bacillus influenzæ* can often be cultivated from the discharges of patients in which bacilli are invisible in stained preparations, are sufficient to my mind to account for most cases of its reported absence. In those infections which possess a more definite symptomatology—as for example, gonorrhœa or meningitis—we do not deny to the gonococcus or meningococcus an ætiological significance in the many cases in which we fail to find them. But while I think *Bacillus influenzæ* is the most likely cause of the late pandemic, I admit it is very far indeed from being the proved cause.

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[1] At a meeting of the Section, held May 9, 1921.

[2] I have been requested by the London Hospital authorities to acknowledge that this paper is largely based on the essay which was awarded half the Liddle Prize, Professor J. MacIntosh taking the other half.

Though I may have demonstrated the constant association of *Bacillus influenzæ* with those epidemic cases that came under my own observation and explained, to my own satisfaction, its reported absence elsewhere, yet there is another fact that requires just as much elucidation—namely, the remarkable prevalence of influenza bacilli in the nasopharynges of healthy sailors. Since 1918 up to the present year I have swabbed at intervals batches of men who exhibited no signs of influenza, and as far as I knew had not recently been in contact with influenza patients. In all 266 men, chiefly venereal convalescents, with apparently normal throats were examined. The percentage of men in each batch harbouring influenza bacilli was roughly the same, about 50 per cent., and this figure showed no obvious relation to influenza prevalence, nor did a previous history of influenza seem to have much influence on the likelihood of a positive result in individual cases.

This tremendous prevalence of so-called influenza bacilli in apparently healthy men requires as much explanation as their reported absence in certain clinical cases. At first sight it would appear that *Bacillus influenzæ* cannot be the cause of the epidemic; because if it is present as a harmless saprophyte in the throats of half the population, its association with clinical influenza might well be incidental. But whatever the cause of influenza may be, in a pandemic of the size we have lately witnessed, the germ is certain to exist in a host of carriers as well as in the epidemic cases, and from this point of view, a high carrier-rate substantiates rather than weakens any claim *Bacillus influenzæ* has of being the specific cause of the pandemic. However, the fact remains that the majority of these carriers seem to be harmless, and this at first sight appears difficult of explanation.

Now let us consider what are the characters usually employed to identify the organism known as *Bacillus influenzæ?* They are its characteristic colonies on certain changed blood media, its absence of growth on ordinary agar, absence of, or feeble growth, on blood smeared agar and its Gram-negative and morphological characters. Suppose, for the sake of argument, we were dependent on two or three culture media only, and the morphology, for classification of the Gram-negative intestinal bacilli; under these restrictions we should only have two or three varieties, which would include the dozens of harmless and noxious species that we know exist. For this reason it is not unlikely that the organism called *Bacillus influenzæ* is not a single organism but a group. Variations in serological reactions and the morphology of different strains are evidence in support of this view. Though even these detectable variations may be considered hyperspecific, yet the changes in bacterial protoplasm correlated with variations in infectivity and virulence are in many cases still further beyond the reach of laboratory technique; and it is on these variations that epidemics depend for their magnitude and malignancy. All workers with vaccines know that while two organisms may be identical from the systematic botanist's standpoint, yet one may prove to have much better antigenic qualities than the other. Without pressing the subject further it may well be that the explanation of the considerable number of influenza bacillus carriers is, that only certain varieties of *Bacillus influenzæ* can cause symptoms of disease.

Before proceeding with some other attempts to solve the carrier problem it may be advisable to consider virulence and infectivity from the biological standpoint. Is virulence really a useful asset to a parasite? If a parasite produces so much toxin and destruction of function as to immobilize or destroy its host it is limiting its own chance of dispersal or survival beyond that single host. Very sick men or corpses have little opportunity of spreading their parasites as compared with those people whose parasites do them no injury, and permit them for long periods of time to wander about among their fellows. Virulence, once the number of susceptible hosts has diminished to a certain point, must be a handicap in the struggle for existence, as the parasite possessing virulence shows an imperfect adaptation to its environment, which is the biological hallmark of a successful species. A non-sporing pathogenic bacterium that destroys its host commits suicide. The destruction of the human race by supervirulent microbes has often been predicted, but these are some of the reasons why this catastrophe has not occurred long ago and is unlikely to occur in the future. Pathogenic organisms are not the successes of the bacterial world—how many more *Bacilli coli communes* are alive to-day than typhoid bacilli?

Infectivity is an attribute that differs from virulence, for it is obvious the more infectious a parasite is, that is the greater the ease with which it establishes itself and breeds in fresh hosts, other factors remaining the same, the more it will succeed as a species. Therefore, once an epidemic is started the more infective strains will tend to be selected for survival. If this view is correct, the question at once arises as to why the whole population does not become infected? In the case of the influenza-like organisms I believe this does happen; seeing that, in my experience, at any instant of time during the last two years a sample of the population produced 50 per cent. of carriers, it is not improbable that if the whole population could have been repeatedly examined, nearly 100 per cent. would have been found at one time or another, for longer or shorter periods, to harbour influenza bacilli.

To understand this last point of view we must turn to the parasite's host, as infection depends on the degree of his susceptibility as much as on the infectivity and mass of the invading parasite. A man infected with an organism reacts against it, and after the usual struggle which may, or may not, be indicated by symptoms of disease, either the man or the organism is generally destroyed, but a third course is possible, and parasite and host may adapt themselves to each other and live in harmony, the result being a chronic carrier. When a man has destroyed or adapted himself to a parasite, certain changes take place that give him for a longer or shorter time various degrees of acquired immunity. In the non-virulent strains of an organism the reaction of the host will not be so intense, and hence non-virulent organisms have a better chance of complete adaptation or anyhow of surviving in their hosts for greater lengths of time. This theory, if correct, would account for the harmlessness of most carriers. However, virulent carriers do exist, and, perchance, the mutual adaptation that takes place in such cases is more on the part of the host. The infected individual learns to tolerate the excretions and ferments of an organism still pathogenic to the general population.

The ease with which an epidemic can spread in a population depends, among other things, on the degree of infectivity of the specific germ and the density, that is the number per unit area, of people susceptible to that degree of infectivity. The epidemic weeds out these susceptible persons until a point is reached when their density is too small to permit further dispersal of the germ. The epidemic in that locality then dies out; meanwhile the wave of infection passes on, and the infectivity of the specific germ increases, until later the same type of germ, but with an increased infectivity, is reintroduced to the localities that had been previously visited, and a second epidemic wave is formed. The victims of the second outbreak being mainly those who, while possessing sufficient resistance to withstand the infectivity of the early specific germs, could not resist the increased infectivity subsequently evolved.

The explanation of the number of harmless carriers of *Bacillus influenzæ* can now be summarized. An organism of the required infectivity having arisen, an epidemic begins, and spreads rapidly through a highly susceptible population, but as the susceptibility decreases the more infectious strains of parasite are selected for survival, and later the more virulent strains are eliminated by natural selection, until finally the organism succeeds in adapting itself to its environment by the evolution of highly infective but innocuous strains which produce a multitude of so-called "carriers" of the original pathogenic ancestors.

I also believe that the late cerebro-spinal meningitis outbreaks illustrated these principles. The disease itself, after a preliminary increase in virulence, undoubtedly became less virulent as time passed, and the drop in mortality from 80 per cent. to 30 per cent. is more than one can attribute to improved antisera. In a paper[1] on cerebro-spinal fever, Dr. Dorgan reported that the carrier rate in a certain garrison actually increased as the number of meningitis cases diminished. An apparent paradox, which is simply explained if it was the case that harmless strains of meningococci were succeeding in adapting themselves to their environment, as the virulent strains were being eliminated by natural selection.

It should be noted that at the commencement of epidemics there is often a preliminary rise of virulence, and it is probable, seeing how virulence often goes with great power of multiplication of parasites in the host's tissues, infectivity and virulence are characters that often increase together. The handicap of virulence is not felt so long as susceptible hosts are sufficiently numerous. Also, the increased mass of infection per individual in severe illnesses may counteract to some extent the immobility and partial isolation severe infections generally cause. The application of biological first principles may also throw some light on the origin of epidemics. Personally I think species of bacteria are much more flexible than most text-books would have us believe. I may have conveyed the idea that increase of infectivity takes place by means of the continuous selection of small variations in the same direction; but modern botanical teaching would suggest that sudden large steps, that is mutations in virulence and infectivity are just as likely, if not more likely, to occur. One objection to the survival of mutations of asexual bacteria is that if only one or two bacilli should acquire fresh characters their offspring would be swamped by the non-mutated bacilli. In nature, however, it is easy to imagine situations in which the mutation of a single bacterium could survive. For example, a cell in the respiratory tract is invaded by a bacillus which mutates while isolated in that cell. Later the owner of the cell sprays it, together with the mutated offspring of the bacillus which it contains, into the nasal passages of another individual. The latter is now infected with a "new disease," and may possibly become the first case of a world pandemic. Should the strain of bacillus arising as a mutation only differ from its non-mutated ancestors in the characters of virulence or infectivity, the "new disease" it causes will in other respects resemble the "old one" it arose from. In this way, perhaps, epidemic influenza may have arisen as a mutation of sporadic influenza.

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[1] *Lancet*, 1919. ii, p. 97.

In case these biological ideas seem out of place when applied to bacteriology, it is well to remember the latter science is only a small branch of botany. Again, a great part of a clinical bacteriologist's time is spent in isolating pathogenic organisms from the numerous harmless bacteria resembling them. Consider, for instance, these different groups—the streptococci, the Gram-negative diplococci, the intestinal bacilli, and the diphtheroids. If we have any faith in evolution we must allow that each of these groups probably had a common ancestor in the past, and from what is known of the mutation of higher plants, it may be that the origin of many species of bacteria is far more recent than is usually presumed.

There is no time to consider the claims of organisms other than *Bacillus influenzæ* to be the specific cause of the pandemic. The remarks already made apply equally well whatever the true germ of influenza may be, for it is almost certain a disease possessing the characters of epidemic influenza will be associated with many carriers. Here I use the term "carrier" in its most literal sense, and include all ambulant and missed cases, the latter consisting of many so-called colds, chills and catarrhs, as well as the man who, though being really ill, forces himself to go about his usual occupation. The number of almost trivial cases of the disease is an especial character of influenza, and doctors, I think, are prone to forget this. Personally, when the word influenza flashes into my field of consciousness, I first visualize purple patients spitting blood and streptococci; the thousands of people with no more than a degree or so of temperature and a headache, keep well away in the background, yet it was they who formed the vast majority of the epidemic cases which were not in most instances seen by the medical profession at all. In Switzerland it was estimated that only one-third of the epidemic cases were seen or notified by a medical man.

The cause of the great variation in individuals and also in groups of cases at different times or in different places is probably three-fold. First, variations of the primary organism; secondly, variable susceptibility of individuals; and, thirdly, and probably most important, different combinations of the bacterial flora causing the illness. This now brings us to the so-called secondary infections.

In times now passing it was customary to try to fix the blame for the different combinations of body changes that constitute a disease on a single organ; for example, pneumonia was a disease of the lungs. At the present time we often merely substitute for the single organ a single kind of bacteria, then pneumonia becomes a pneumococcal infection, when in many more instances than is generally recognized, pneumonia and other diseases are due to a combination of parasites rather than to any single species. The most familiar example of this is "consumption," in which the secondary invaders, when once established, do a greater amount of harm than the tubercle bacillus itself. So with influenza, whatever the primary parasite may be, it depresses the resistance of the patient so that any pathogenic organisms in the environment seem able to infect with increased virulence, the result being a complex disease in which the secondary invader may play the more important part. I will illustrate a compound infection by means of a rather uncommon case from my own experience. A man was admitted to H.M. Hospital Ship *Agadir* during the height of the epidemic: he was suffering from the broncho-pneumonia prevalent at the time. His sputum contained *Bacillus influenzæ* and hæmolytic streptococci, while a blood culture revealed similar streptococci and typhoid bacilli. Here was a man with three definite infections, and possibly a fourth, if we consider his illness primarily due to the epidemic and refuse to admit *Bacillus influenzæ* is the specific cause.

Among the secondary infections the streptococci and pneumococci attracted most attention because of their association with the severe pulmonary cases; but secondary invaders were just as common in the uncomplicated cases, which are better designated as cases without definite pulmonary symptoms. Among these latter cases the commonest organisms in my experience found in association with influenza bacilli were Gram-negative diplococci and pneumococci. In the early spring cases of 1918 the predominant secondary organisms I found were Gram-negative diplococci, and similar organisms were common in a small outbreak this year (1921) at Portsmouth. In the former cases I failed to demonstrate *Bacillus influenzæ*, a fact I attribute to the use of an unsatisfactory culture medium—namely, blood smeared agar. In this year's cases *Bacillus influenzæ* was recovered from fifteen out of sixteen influenza patients, using Fildes pepsinized blood media.[1] These two groups of cases were clinically very similar, as I can vouch for personally, as I was in charge of their treatment as well as of the bacteriological examinations in both instances.

There is another point worthy of more emphasis than is generally attached to it. The pulmonary complications of influenza are usually present from the onset of the illness, this suggesting that the so-called secondary infections are not really secondary in time but are contracted simultaneously with the primary specific infection. Such observations introduce the interesting possibility that influenza is always a compound infection of *Bacillus influenzæ* plus some other organism, either moiety of the combination increasing the virulence of the other. Animal experiments have been published which indicate that admixture of *Bacillus influenzæ* with small and otherwise innocuous doses of other organisms greatly increase the former's virulence, and vice versa, small doses of *Bacillus influenzæ* increase the toxicity of other organisms.

The inhibition of the normal blood cellular response to those infections which are usually accompanied by a leucocytosis may be part of the mechanism by which the influenza virus lowers the resistance of its victims to other parasites. In normal times it is rare to get white blood counts of under 10,000 per cubic millimetre in lung conditions due to the pneumococcus or streptococcus. Yet among thirty-seven pulmonary influenza patients, whose leucocytes were counted, only eight had more than 10,000 per cubic millimetre and in no less than fifteen of these patients there was a leucopenia (white count less than 5,000 per cubic millimetre). It is the absence however of a leucocytosis in so many cases with inflamed lungs rather than any marked leucopenia, which is the striking feature of these leucocyte counts. Thus it may be that *Bacillus influenzæ* is unable to become pathogenic without assistance from other micro-organisms. The influenza virus, by lowering the resistance of the patient, permits other parasites to invade the tissues, and perhaps, in return for this service the secondary invaders provide some product essential to the influenza germ. *In vitro*, influenza bacilli sometimes form compound colonies on culture media and they are said to grow in association with staphylococci on media they are unable to survive on alone. The compound nature of the infection in most cases of influenza explains the pleomorphism of the disease among both individuals and batches of patients. For example, so marked is the difference in the symptoms of pulmonary cases infected with pneumococci or streptococci that one could nearly always guess the infection before any bacteriological examination had been made. At Scapa Flow the pneumococcus was the predominant cause of inflamed lungs at the time streptococcus was working its ravages in the South of England, though hæmolytic streptococci became more prevalent at Scapa as the autumn to winter epidemic proceeded. Biologists are yearly adding more and more facts bearing on the widespread importance and significance of mutualism and symbiosis in organic nature, and there are undoubtedly mutual relations between the parasites of man and man himself, of which we have not as yet more than the haziest indication.

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[1] *Brit. Journ. Experi. Path.*, 1921, ii, p. 16.

I now propose to refer to a few ships of the Royal Navy and see how far the epidemic as it affected them bears out the principles I have just enunciated. In the Grand Fleet just over 10,000 men were reported sick in the spring wave of the epidemic while in the autumn only about 5,000 were attacked by influenza. At first sight this looks like a lowering of the infectivity of the germ but I hope to show the lesser incidence in the autumn was chiefly due to an increased resistance of the personnel of the fleet combined with improved quarantine regulations. The case-mortality in the two waves was respectively 0·03 per cent. and 2·8 per cent. which is nearly a hundredfold increase of killing power; yet though I may be accused of straining a fact to fit a theory, I believe this increase was more likely to be due to prevailing secondary infections than to any increase of virulence in the primary specific cause of influenza.

Turning to an individual ship I will first take H.M.S. *Revenge*. This ship suffered from two definite outbreaks and her experience is a model of what happened in many other ships. In her the first wave lasted about twenty days, 207 men—17 per cent. of the ship's complement—were officially reported as sick. The autumn wave lasted about the same time, 20 per cent. of the ship's company being returned sick. This makes a total official attack-rate for the two outbreaks of 37 per cent. Surgeon-Commander Burniston, the senior medical officer of the *Revenge* (whom I must thank for giving me this information) states in his official report that quite half as many again were ill without going off duty, so the official attack-rate is much below the real attack-rate and 50 per cent. is much nearer the real number attacked in the combined outbreaks.

I will now take two examples from ships that escaped the first wave of the epidemic. First H.M.S. *Newcastle*: Surgeon-Commander Page published an account of this outbreak from which I have taken these notes. During the first fortnight of October, 1918, 51 per cent. of the ship's company of 450 men were attacked by an illness consisting of three or four days fever, headache and backache. Dr. Page writes: "There was a complete absence of any malignant symptoms or complications." All cases returned to duty within a few days. The examination of stained films of sputum were said to reveal "numerous Gram-negative bacilli resembling Pfeiffer's bacillus," also Gram-negative cocci were noted in some of the films. This outbreak started seven days out at sea and ran its course far from land in the South Atlantic. The extreme mildness, but high infectivity, of the illness is a point worthy of careful attention.

The second example of a ship to be infected in the autumn only is H.M.S.

Africa. Of her complement of 779 men, 75 per cent. were struck down with a serious illness. Surgeon-Commander Alderson who kindly let me abstract this information from his official journal, tells me that, as far as he had time to observe, many cases were pulmonary in type from the onset and their expectoration was blood-stained. Fifty-one men died, a 9 per cent. case-mortality or nearly 7 per cent. of the ship's complement. Some samples of sputa were sent ashore for examination, but apparently only stained films were made, and a "Gram-positive diplococcus" was reported to be the predominant organism seen. There was no mention of influenza-like bacilli, but this is no evidence of its absence if cultures on suitable media were not made at the time direct from the cases.

The above three ships are type examples and there were many ships of each type. The *Revenge* is the two-wave type generally seen in home waters. The *Newcastle* is the highly infective but very mild type, while H.M.S. *Africa* is the super-virulent and infective type of ship. The last two were commoner in foreign waters.

Roughly generalizing, it may be said that in the spring in an early wave of the epidemic the attack-rate was 25 per cent., with a further 25 per cent. when the wave of the epidemic returned in the autumn. These two attack-rates combined make 50 per cent. which, it is most important to notice, is the same as the attack-rate of the ships which escaped the early wave and only got attacked when there had been time for an increase of the specific organism's infectivity. The conclusions I draw from these morbidity-rates are that a ship's company, and possibly the population as a whole, consist of a quarter highly susceptible to influenza who succumb, leaving three-quarters unaffected; but when the parasite has gained sufficient infectivity in its travels and returns, it attacks a further but different quarter, the quarter originally attacked with few exceptions having gained sufficient immunity to resist a second attack even after the infectivity has increased. Half the population remains free from attack in both waves because it possesses a natural immunity sufficient to resist the degree of infectivity the organism has acquired at the time of a subsequent invasion. The total morbidity for a locality is roughly the same when passed over by a late wave of the epidemic whether or not it has received the doubtful benefit of recent earlier visitations.

The main differences between the *Newcastle* and *Africa* outbreaks are that in the former the disease was mild, the mortality *nil*, and influenza-like bacilli predominated in the sputa; whereas in the latter the illness was severe, with 9 per cent. of deaths, and Gram-positive cocci were in evidence in the sputa. This difference is most simply explained by supposing that in the *Newcastle* epidemic *Bacillus influenzæ* was the primary infection, either alone, or combined with a mild secondary bacterium such as *Micrococcus catarrhalis*, while in the case of H.M.S. *Africa* the primary agent was combined with a virulent organism, which was responsible for the great increase of malignancy. The *Newcastle* experience seems to show there was, if anything, a decrease in the virulence of the influenza virus when unassociated with dangerous secondary invaders, as the occurrence of 240 cases with no complications at all was exceptional in home waters, even during the spring; but though the virulence in this case showed no increase, the infectivity was double that seen in ships during the spring.

A point of great importance in the rate of spread of epidemics is the amount, extent, and rapidity of migration and mixing that is taking place among the peoples of the world. At no time in the world's history was the value of these factors so high as during the period of the late pandemic, and it may well be that the rapid transference of strains of organisms, from individual to individual, and from place to place and back again, gave both the primary and secondary infections those changes of environment necessary to produce the alterations in the characters of virulence and infectivity that undoubtedly took place.

The outbreak at Sierra Leone in West Africa may illustrate one way the epidemic travelled. H.M.S. *Mantua* left England in August, 1918; two days out influenza appeared on board. She touched at Sierra Leone on the 15th and coaled with coolie labour. She then had had over 200 cases of influenza. By August 25, that is ten days later, the influenza epidemic was so bad ashore that there was insufficient coolie labour to coal ships on their way to England. So H.M.S. *Africa* and *Britannia* lent parties of men to help coal these ships. In this way it is presumed the *Africa* got infected. Anyhow most of the first influenza patients were men who had formed part of the coaling parties. We may suppose the white men in H.M.S. *Mantua*, or some other ship, infected the black coolies, who passed the infection back, via the colliers, to the white sailors of H.M.S .*Africa*; and it is not improbable that this passage through a different variety of man may have increased the virulence of the infecting germs and account for the malignancy of the disease in H.M.S. *Africa*. The *Africa* now returns to England bearing a cargo of bacterial strains of increased virulence and infectivity for use in the autumn wave of the pandemic. Besides migration, the rate of spread in any area is a function of the density of susceptible persons and the mass of infection, which depends on the number of cases and carriers, in that area. The density of susceptible persons in a ship must be very great as compared with an assemblage of susceptible persons on shore. If, for example, we contrast the sleeping accommodation in a ship with that of a big institution, we find that in the ship hammock hooks are less than 2 ft. apart, whereas institution bed centres are rarely less than 8 ft. apart. Even when head to toe slinging is insisted on in a ship the men's heads must often be within 3 ft. of each other. Now the volume of spray from a mouth at 3 ft. is nearly twenty times that at 8 ft. Therefore how much more readily will the man sleeping in a battleship's mess-deck get a requisite dose of infectious material than the man sleeping in an institution ashore? Again we also hear of many men in a ship not ill enough to go off duty, and, thus being immobilized, wandering about among their fellows.

When we consider these points, and at the same time realize that a modern battleship, with its tiers of lumbered decks, its cramped accommodation, and its crew of often over 1,000 men, covers an area of less than one-fiftieth of a square mile, I do not think it possible to doubt the infective material must become so dense and diffused as to saturate the ship. That is to say, everyone on board receives a dose of the specific agent sufficient to cause influenza, unless he happens to be highly immune at that time to the strain of organism responsible for the epidemic. In a ship, the density of susceptible persons, the mass of infection, and the local migration are all so great that any diminution in one or more of these factors that may be produced by the use of sprays and gargles, by early isolation of cases and disinfection, is scarcely likely to diminish the rate of spread in a ship, once influenza has obtained a footing on board. And I think naval experience, where all these preventive measures have been vigorously employed, justifies this pessimism, as I have been unable to learn of any definite cases in which they did any good. In ships the outbreaks lasted ten days to three weeks; ashore the wave took about three months to pass over a locality. The longer wave period ashore was probably due to the lesser density of susceptible persons and infective sources, more time being required for the infection to hunt out all the susceptible individuals within its reach.

I mentioned above that the attack-rate for the whole fleet, as distinct from single ships, in the second wave was only half that in the first; a fact probably due to the escape of whole ships, rather than diminished incidence in ships thoroughly infected during the autumn. Improved quarantine regulations may have made the transference of the virus from ship to ship more difficult. Perhaps an immunizing effect of the earlier wave may have decreased the susceptibility of the fleet as a whole, but the figures from individual ships suggest that the number of susceptible individuals was the same at the time of both outbreaks.

Naval experience indicates that a previous attack of influenza confers some immunity. According to Sir Robert Hill's figures, the attack-rate in the autumn among those who were victims of the spring epidemic was 1·8 per cent., as against 5·6 per cent. of those to escape the early outbreak. But these figures also indicate how far this immunity was from being absolute, even after a period as short as six months.

It may be of interest to turn now to ships that were infected this year (1921). Between January 17 and February 15, H.M.S. *Fisgard* returned eighty-two cases of influenza, which was 7 per cent. of the ship's company. Between January 13 and February 7, H.M.S. *Royal Sovereign* returned sixty-one cases, or 6 per cent. of 1,050 men. It should be admitted that many of these cases were little more than "feverish colds" but were mixed up with undoubted cases of clinical influenza, and fifteen out of sixteen examined harboured *Bacillus influenzæ*. These two ships were among the most heavily infected at Portsmouth this year, yet a 7 per cent. incidence was far below the average attack-rate of ships who had influenza outbreaks in 1918-19. Those who believe the specific cause of this 1921 outbreak was the same as that of 1918 can explain these figures as follows. Only 7 per cent. got influenza because the remaining 93 per cent. were always immune to the disease or had acquired immunity in 1918. But when we turn to the 7 per cent. to be attacked this year it is found that about half of them admitted a previous attack of influenza during the last three years. These may be considered to be hypersusceptible individuals on whom a previous attack had conferred no lasting immunity. The other half, who gave no previous history of influenza, and had come unscathed through the 1918-19 epidemic, may have succumbed this year because their natural immunity had decreased since 1918, or because they had been isolated from infection in 1918. Perhaps however the strain of influenza of 1921 is entirely different to the 1918 strains and requires different specific antibodies to resist it. Personally I prefer the first explanation, and I think if we contrast the condition of the world with regard to influenza at the beginning of 1918 and 1921 we can roughly state it to be something like this: In 1918 about 50 per cent. of the population were susceptible to influenza and 50 per cent. immune to ordinary doses of the virus. In 1921 the population consists of 90 per cent. immune to ordinary doses of influenza germs, 5 per cent. of a hypersusceptible class who will get influenza whenever exposed to infection, and 5 per cent. ordinary susceptible subjects who escaped previous infection.

I have not considered the influence of food, fatigue, race or weather on the epidemic, as the part they played cannot have been of great importance seeing the way in which the epidemic attacked without distinction rich and poor, black and white, lazy and energetic, in all kinds of climates, weathers, and seasons. The more important points these naval outbreaks seem to indicate better than figures obtainable ashore are that the second wave of the epidemic must be attributed to an enhanced infectivity of the parasite, rather than to an increased immigration of susceptible hosts into a locality, though I believe the latter theory is the more popular view. The marked variation in virulence is almost entirely a function of the prevalent secondary infections, a point so well brought out by the contrast of the illness in H.M.S. *Newcastle* and *Africa*, when both these ships had been infected with autumn strains of influenza. In the report on influenza issued by the Ministry of Health there are some very interesting statistics and graphs of the incidence of influenza in merchantmen.[1] The writers tentatively suggest these curves indicate a three-phase epidemic in ships, analogous to the three-wave epidemic seen ashore, but running its course in days instead of months. But in H.M. ships, where the same crew remained unchanged all through the whole epidemic of 1918-19, though the period of the waves was a tenth to a sixth of the wave-periods ashore, yet the lapse of time between the spring and autumn waves in ships was if anything longer than that usual ashore. This interval was twenty-seven weeks in the *Revenge* and twenty weeks in the *Royal Sovereign*, as compared with sixteen weeks in London ; I therefore think the three-phase outbreaks in the merchant ship graphs must have been coincidental, though there may be indications of a similar phenomenon in some of the graphs I have of the naval outbreaks.

I have purposely left out all consideration of the third epidemic wave in the Navy, not because I think it vitiates the conclusions I have come to above, but because I was unable to obtain enough figures relating to it and was unable to find any ship to show three definite waves comparable to the two waves as typified above in H.M.S. *Revenge*.

From the preventive medicine point of view I think we have learnt the following lessons in the Navy : First, that gargles, sprays, disinfection, and isolation can have little effect in checking influenza in the crowded conditions that exist in warships. But there is evidence to show the disease can be kept from spreading from ship to ship and from shore to ship if really strict isolation is enforced. But the quarantine must be absolute. It is altogether useless to allow a favoured few to go ashore such as certain officers, mess-stewards, postmen, and duty boat's crews. In the Royal Navy it is quite possible completely to isolate a ship; boats from other ships and shore establishments can bring stores and mails alongside, and these can be hoisted in without any contact between the ship's crew and the men in the boat. Only in this way can the disease when it has once broken out in a ship be prevented from spreading to the rest of the fleet or even infecting a whole country. If men are on leave in an epidemic area, it is better to let them stop there rather than to return to infect their ship and, perchance, the whole fleet. As regards other methods I think Sir William Leishman's figures for the Army prove the value of prophylactic vaccination. It probably diminished incidence threefold and mortality twentyfold. Even should the vaccine not contain the specific antigen of influenza, it contains the antigens of the lethal pulmonary infections and for this reason alone vaccine is worth using.

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[1] Reports on Public Health and Medical Subjects. No 4: Report on the Pandemic of Influenza, 1918-19 (Ministry of Health) 1920, pp. 57-65.

At the first sign of an epidemic compulsory vaccination should be enforced and usually there should be plenty of time. For if we had known in 1918 what we know now, we should have had a month's warning that it was time to vaccinate the fleet, as the epidemic was well under weigh in China and America in March and did not appear in the fleet until April. As in the case with most prophylactic measures, vaccination if used at all, must be thorough. Every soul in the Navy must be vaccinated and not allowed ashore until it is done. "Conscientious objectors," protecting themselves at the expense of society, should not be allowed ashore till the epidemic is over. If vaccination were practised in this way there is hope it would lead to such a diminution in incidence, virulence, and rate of spread, that even if a vaccinated ship became infected, all cases could be treated efficiently on board, without overtaxing the medical arangements or interfering with the efficiency of the ship as a fighting unit: and by this means the only other satisfactory preventive measure could be more easily enforced, namely, absolute isolation.

In conclusion I must apologize if I seem to have made rather sweeping assertions on somewhat flimsy evidence. I can only say that the subject was rather large to do justice to in the time, and that this paper is condensed from a much longer essay.

DISCUSSION.

The PRESIDENT (Sir Robert Hill) said that he was struck with the similarity between the epidemic of 1918-19 and that of 1889-90. Cases in both epidemics began in the same way—a sharp onset, collapse for twenty-four to forty-eight hours and a rapid recovery. The epidemic of 1889-90 was followed in the late autumn by a broncho-pneumonia which killed old people and young children. But in the serious return wave of the 1918-19 epidemic boys and senior officers (men in their fifties) seemed to escape better than men in their thirties. This was very noticeable in the crews of destroyers, where there was considerable mortality amongst men in their late twenties and thirties. The development of severity in an influenza epidemic had its parallel in measles. The first cases of measles in a school were generally mild, but the outbreak became more virulent until 30 to 40 per cent. might be affected.

Surgeon Rear-Admiral P. W. BASSETT-SMITH said that Surgeon-Commander Dudley, in his most interesting and thoughtful paper, had reached a high plane of ætiological and epidemiological speculation. He (Admiral Bassett-Smith) thought there was some doubt about the mutability of the species mentioned and the organism which was primarily the cause of the disease, but there was no doubt that this primary virus gave rise to a condition in the lungs, namely, a blood-stained œdematous fluid, which was a most favourable medium for the growth of such pathogenic organisms as the pneumococci and streptcococci so frequently found in certain phases of the epidemic. With regard to immunity—judging from the figures which he was able to work out—there appeared to be a certain amount of protection conferred on those who had suffered in the spring epidemic against the autumn epidemic, but much further statistical evidence was required on this point. Referring to vaccines, in which he was particularly interested, he emphasized the importance of early and thorough immunization of ships' companies, &c., and the fact that practically all investigators in Australia, New Zealand, France and Great Britain, recognized that vaccination at least reduced the mortality. He quoted the following interesting report of Surgeon-Commander Sutton, R.N., as an instance of the prophylactic value of vaccine in the Royal Navy: "The staff here consists of four medical officers. Two of these were taken ill on October 19. The other two were both inoculated at once and, though very much overworked and exposed to infection, we both escaped. Also four of the staff of twelve nurses here had been taken ill before the inoculations started. All were inoculated, and there were no more cases among them. All the sick berth staff, consisting of eight men. were inoculated, and they all escaped. This is in itself a testimonial to its great value. When the inoculations were started the epidemic was at its height. The severest cases were coming from small mine-sweeping vessels ; it was quite common for the whole of the small ship's company (consisting of about five men) of one of these vessels to be taken ill in one day with the influenza, so that a relief crew had to be sent. All the ship's companies of these vessels. consisting of over 138 men, were done at once. The influenza at once stopped in these ships. and only two cases of a mild nature occurred among them.

RESULTS.

	Number	Cases
Inoculated	1,368	2·8 per cent.
Not inoculated	2,801	13·4 per cent."

Dr. BERNARD MYERS said that the influenza epidemics had affected the members of the New Zealand Expeditionary Force fairly severely. A certain number had suffered from the "heliotrope variety" with practically uniformly fatal results. On one transport with 1,150 officers and other ranks which had arrived in England early in 1918, influenza had been evidently contracted at Freetown and about 900 cases with eighty-three deaths had resulted. It appeared that the commander of one of the British warships there had called a conference on board his ship of all captains of transports. On shore influenza was apparently taking distinct toll of the natives and there had been a certain number of severe cases with deaths on the warship. The captain of the New Zealand Expeditionary Force transport sat next to the captain of the warship. The former did not suffer from influenza subsequently although he felt rather "off colour" for the few days following. There had been absolutely no contact between shore and transport although some provisions were apparently delivered to the ship's side. Influenza had begun when the ship was about four days out and increased quickly in violence until practically all of the soldiers were more or less affected. The symptoms were overwhelming, and in fatal cases the victims lived only two to three days after the appearance of actual symptoms. In 1917 a mixed catarrhal vaccine had been first made for them by Dr. Eyre and Dr. Lowe. It contained *Bacillus influenzæ*, pneumobacillus, pneumococcus, catarrhalis, and *Streptococcus hæmolyticus*. Two inoculations had been made at ten days' interval. There was no question of the distinct utility of this vaccine. They had arranged for practically our entire forces in France, Egypt, and the United Kingdom to be inoculated. It had certainly helped to decrease the case incidence and mortality. Every man, before embarking on a transport, had been inoculated, and upon proceeding on board ship had been passed through the inhalation chamber (zinc sulphate). An endeavour had been made to arrange hammocks so that spray infection would be minimized. Plenty of fresh air had been provided and men encouraged to report sick at once, when immediate isolation and disinfection were carried out. By the above-mentioned means influenza almost disappeared from the New Zealand Expeditionary Force transports.

Squadron Leader H. E. WHITTINGHAM, R.A.F., M.S., said that Surgeon-Commander Dudley's paper had presented the Section with a full and yet concise account of the recent influenza epidemic as it had occurred in the Royal Navy. The published reports of work done in influenza in the Army and Royal Air Force all bore testimony to one outstanding fact, namely, that various competent observers, working in different places often with different technique, obtained very similar results. In some waves of the epidemic the number of cases from which the *Bacillus influenzæ* was isolated had been small, in others large. And not only that, but the predominant, so-called "secondary infecting" organisms in each epidemic had been found to be the same by most workers. Moreover, workers using one and the same media throughout the various epidemics had obtained a very different number of positive influenza cultures according to the epidemic investigated. This would point to the fact that the high percentage of *Bacillus influenzæ* "carriers" now to be found could not be entirely accounted for by the improvement in technique, as Surgeon-Commander Dudley had put it. The high percentage of *Bacillus influenzæ* "carriers" rendered it very difficult to diagnose bacteriologically a case of influenza, even with fairly typical clinical signs. Some help might be obtained from the blood picture. In the Royal Air Force extensive blood pictures had been made during the various epidemics. From these, three distinct types of blood pictures had been elucidated: *Type I*, influenza uncomplicated; *Type II*, pneumonic form of influenza: *Type III*, lethargic form of influenza. In Type I there was a leucopenia accompanied by a relative lymphocytosis. On the third to fifth day of disease a moderate degree of leucocytosis set in with a relative neutrophilia. This was the blood picture seen in simple *Bacillus influenzæ* infection. Type II presented a distinct leucocytosis from the onset with a relative neutrophilia. This was well seen in so-called "secondary infections"—i.e., cases where the *Bacillus influenzæ* was not the predominant organism. Type III showed an initial leucopenia which daily became more pronounced until death occurred, usually in three to five days. Here there was apparently a failure of the defensive powers of the body. Generally speaking, a leucocytosis was a good sign, a persistent leucopenia a serious sign. Hence the advisability of giving vaccine treatment to try to produce a leucocytic reaction. Incomplete recoveries and the oncoming of a relapse could often be diagnosed from the blood picture, even when the clinical signs were slight or absent. The mutability of the influenza bacillus had been discussed at some length, but little had been attributed to the atmospheric conditions in bringing about these changes. That they had an effect was suggested by the occurrence in spring epidemics of laryngitis and pharyngitis, in summer of diarrhœa and other intestinal symptoms, and accompanying the humidity of autumn pneumonic symptoms. Their knowledge of the action of the endocrine glands in microbic infections was in its infancy. Such action might account for the 1918 epidemic chiefly affecting young adults. It was known that adrenalin given before the administration of certain vaccines, sera, and other organic compounds prevented the occurrence of rigors and other untoward symptoms.

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